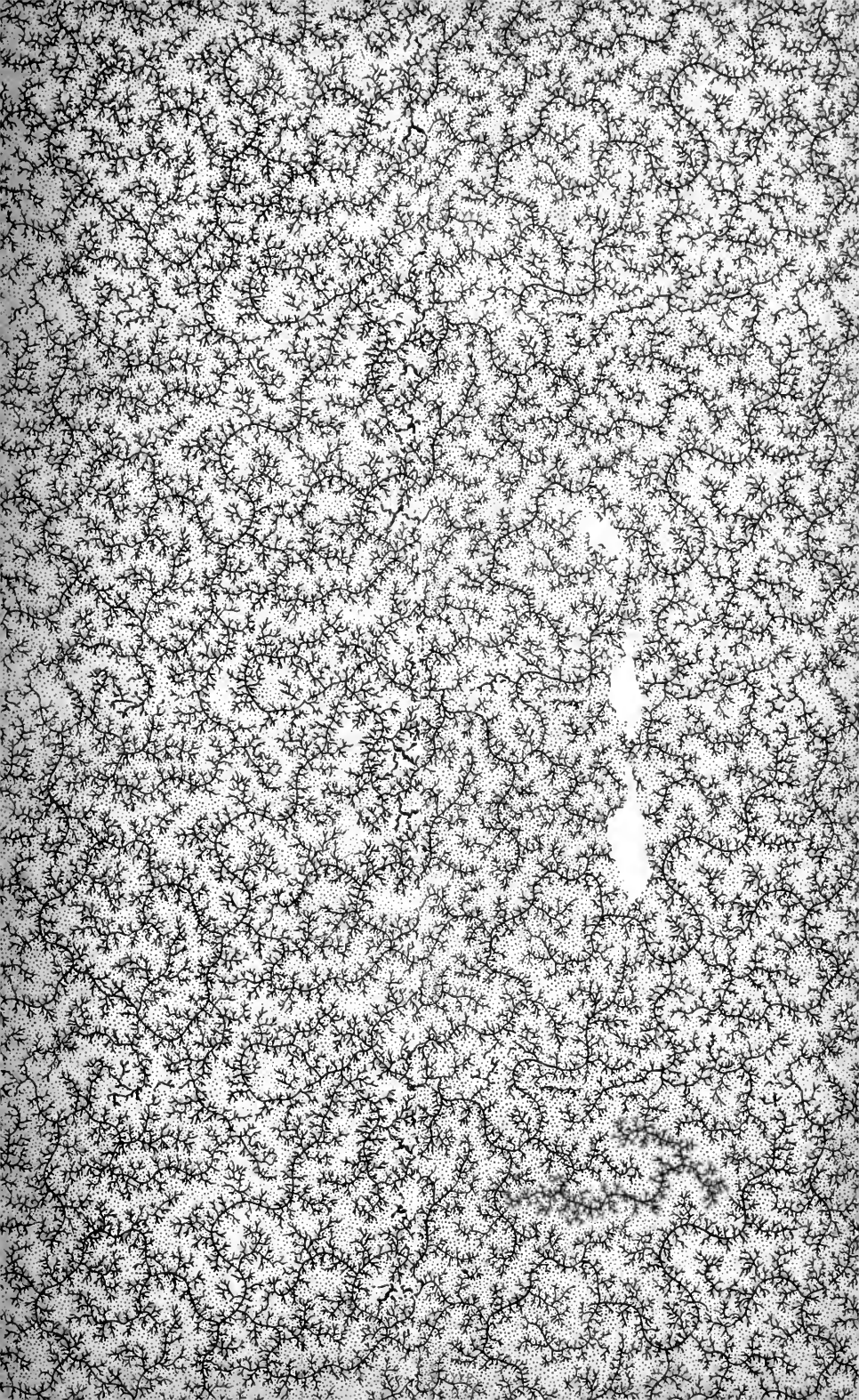

ORTHODONTIA,

OR

MALPOSITION OF THE HUMAN TEETH;

ITS PREVENTION AND REMEDY.

BY

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Approved by the National Association of Dental Faculties as a text book for use in the schools of its representation.

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To My Father,
SIMEON GUILFORD,
THIS WORK IS
AFFECTIONATELY INSCRIBED.

PREFACE.

This work has been written at the request of the National Association of Dental Faculties in furtherance of its plan to secure the preparation of a series of text-books for use in American Dental Colleges. After its completion and examination, it was accepted and endorsed by the Association at its meeting in Saratoga, August, 1889.

The impartment of instruction in the simplest and most direct manner being the true province of a text-book, the author has endeavored in the preparation of this work to treat the subject as concisely as possible and to clothe his thoughts and those of others in such language as to be readily comprehended by beginners as well as those somewhat advanced in this branch of study.

In the treatment of the subject, the aim has been to lead the student step by step from the simplest beginnings to the more complicated and difficult work of practical treatment. To this end, the underlying principles of the art are first elucidated, after which the principal methods employed are explained, and lastly the correlation of principles and methods is shown in their practical application to typical cases. In Part III, the different forms of irregularity, together with a variety of plans for their correction, are arranged under such headings and in such order as to be readily referred to in seeking aid for cases that occur in office practice.

Should the work fulfill the object aimed at in its preparation, the author will feel amply repaid.

Credit for assistance is most cheerfully given to the twenty-five teachers of this branch in American Dental Colleges who have read this work in manuscript, and by friendly criticism and valuable suggestions added much to its completeness.

The author would also acknowledge his indebtedness to Prof. W. F. Litch for valuable services, and to the S. S. White Co., Lea, Brothers & Co., P. Blakiston, Son & Co., and other publishers and authors for the use of certain cuts.

S. H. G.

Philadelphia, Sept., 1889.

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ORTHODONTIA.

PART I.—PRINCIPLES INVOLVED.

CHAPTER I.

DEFINITION OF SUBJECT.

Orthodontia, from ὀρθός straight, and ὀδούς a tooth, is that branch of dental practice which relates to the correction of irregularity of position of the human teeth.

Its recognition as a distinct branch or speciality of general dental practice has come about in recent years, indeed, it attracted so little attention less than a century ago that many of the writers of that day entirely omitted it from their books and writings, while those who did refer to it gave it but little attention and space. Whether the condition of irregularity was less frequently met with then than now we cannot certainly tell, but inasmuch as dentistry was then in its infancy, and as the most pressing demands upon the dentist of that day were for the alleviation of pain, the substitution of artificial dentures to replace lost members, and the checking of the ravages of decay by filling, it is but natural to suppose that there was little time or inclination to attempt the relief of so apparently unimportant a condition as mere irregularity of position. Since then, however, with the natural growth of dental science and the enlargement of its sphere, the subject of orthodontia has grown in importance until to-day it

is engaging the attention of some of the best minds of the profession and forms one of the most generally discussed topics of dental gatherings everywhere, besides constituting an important part of the study of every dental student.

With the growth of its interest and importance there has been a corresponding advance in investigation as to the cause and frequency of irregularities, a more exact microscopical examination of the tissues concerned and of the physiological changes occurring in them in the process of correcting such conditions: progress has also been marked by the invention of a multiplicity of devices and appliances for the more perfect and easy correction of this class of deformities.

REGULARITY AND IRREGULARITY DEFINED.

The teeth of man when normally placed in the alveolar arch describe in outline a parabola or semi-ellipse with a slight flattening of the curve in the region of the incisor teeth, and a consequent tendency to angularity where the cuspids are placed. The outline of the lower arch differs from the upper principally in the greater divergence of the terminals of the curve. The teeth when thus placed should be in contact, each one touching its neighbors at the most prominent points of its approximal surfaces. When thus arranged the teeth are called regular.

An irregularity may be defined as any variation from the above order. It may consist in a variation from the normal outline on the part of several or all of the teeth, or in the malposition of one or more individual teeth; if the latter, the tooth or teeth may be found outside or inside of the regular line of the arch or they may be placed anteriorly or posteriorly to their normal positions, or finally, they may be turned or twisted on their axes. In many cases this torsion is associated with malposition.

An irregularity being an abnormality, corrective measures, as a rule, should be resorted to, but slight irregularities do not always demand interference.

The slight overlapping of the superior centrals by the laterals, for instance, is a clear case of irregularity, but it is so slight a one and so commonly found that it has almost ceased to attract attention or to be regarded as an irregularity. Artificial teeth are now made reproducing this condition and in many cases are preferred on account of their "more natural appearance."

So too, the slight irregularity so commonly found in connection with the inferior incisors, where several or all of them are slightly turned and overlapping, is no longer looked upon as inharmonious and is also imitated in the arrangement of artificial teeth.

Again, the slight misplacement of a tooth in the posterior part of the arch, where it is not noticeable, if it does not interfere with proper occlusion or specially invite decay, may be left without disturbance and no harm result.

In cases like these, if the slightly altered position of the individual teeth is not likely to result in injury to tooth structure, it is best to omit any effort toward correction.

CHAPTER II.

ETIOLOGY.

The causes responsible for the production of irregularity are many and at best but imperfectly understood. Some of them are operative before the birth of the individual and others afterward. They may therefore be classed under the two general heads of hereditary and acquired.

HEREDITARY.

This class comprises all such cases as are evidently due to the inheritance of peculiarities that existed in their near or remote ancestors, or to some of the characteristics of both parents who are themselves free from dental abnormality.

The well-known biological law of transmission of characteristics from parent to child will readily explain how the abnormalities as well as the normalities may be transmitted. The child may bear a close resemblance to either parent in form and feature, or it may combine some of the peculiarities of both. In other cases it will resemble neither, but be like one of the grandparents or other remote relations.

The evidences of inheritance are perhaps nowhere more clearly expressed than in the dental organs. Not only in these organs as a whole may we see the dental apparatus of a progenitor reproduced in entirety, but the resemblance is equally well shown in the inheritance of so slight an abnormality as a twisted or misplaced tooth. Sometimes such peculiarity may be inherited by several children in the same family.

Cases of irregularity due to inheritance are oftentimes the most difficult to correct, for not only must mechanical difficulties be overcome, but in addition the influence of physical impress, confirmed perhaps by repeated transmission,

must be combatted. The mechanical difficulties in such cases are as readily conquered as in others, but the force of inheritance will show itself in a strong and stubborn tendency of the teeth to return to their former abnormal position.

The intermarriage of races with widely differing characteristics has come to be regarded as one of the most prolific causes of dental irregularity. If both races represented in the marriage possess somewhat similar characteristics as to size, vigor and feature, no dental peculiarity will usually be found in the offspring; but where the differences are marked, irregularity of the teeth will often be the result.

When one parent possesses a large frame with full-sized teeth set in large jaws and the other a small frame with correspondingly small jaws and small teeth, the child may inherit the large teeth of one parent and the small jaws of the other. The small jaws cannot accommodate the full complement of the larger teeth and hence a crowded and irregular dental arch will be the result.

Where the small teeth of one parent and the large jaws of the other are found united in the offspring, abnormal interdental spaces will frequently be the result. These spaces may exist between all of the teeth, or, as in some cases, the deformity will only be found in connection with the anterior ones. Cases of this character, fortunately, are infrequently met with, but when they occur they present an unsightly appearance and generally result in an earlier loss of the teeth from that lack of contact and mutual support so necessary to their longest retention and usefulness.

ACQUIRED.

The causes productive of irregularity during dentition or subsequent to it far exceed in number those due to heredity.

LONG RETENTION OF DECIDUOUS TEETH.

In accordance with physiological law, the deciduous teeth are intended to subserve the wants of the child until they

are replaced by the permanent set. The crown of the permanent tooth should occupy a position beneath or adjacent to the root of the deciduous one which it is intended to supplant. Then, as the root of the temporary tooth is gradually removed, the permanent tooth advances and finally occupies the position previously occupied by its predecessor.

It frequently happens, however, that the crypt of the permanent tooth is situated at some little distance from the root of its corresponding deciduous one, and as the new tooth makes its way into place it assumes a position to the side of the deciduous root. As usually that part of the root is absorbed which is in contact with the vascular covering of the advancing crown, a portion of the length of the root remains unabsorbed and the new crown is, in consequence, compelled to advance by the side of the root instead of beneath it. The deciduous tooth as a result of its only partially absorbed root, remains firmly in place and the new one is erupted out of its proper position. Had the condition been brought to the knowledge of the dentist before the new crown appeared, the extraction of the deciduous tooth would have permitted the advancing tooth to assume its proper position in the arch and irregularity have been prevented. When the permanent tooth is advancing out of position the fact may be recognized by the unusual distension of the gum and alveolar plate beneath, and the deciduous tooth, no matter how firmly set, should at once be removed. Even the spicula of a deciduous root has been found sufficient to deflect a permanent tooth from its course during eruption.

EARLY EXTRACTION OF DECIDUOUS TEETH.

That the premature extraction of deciduous teeth often prepares the way for irregularity of the permanent set is generally recognized, but the extent of its importance and the manner in which it operates can best be understood by considering the physiological facts in the case.

Irregularity of the deciduous teeth is a condition very seldom met with. As a rule they occupy their normal positions in an alveolar arch of proper size to accommodate them, and this again rests upon a jaw bone of suitable amplitude. Thus jaw, process and teeth are harmoniously correlated. As each deciduous tooth is lost it is succeeded by the corresponding permanent one, which, under normal conditions, will occupy the space made vacant by the removal of its predecessor. In this way, one by one, the permanent set should make its appearance until all of the deciduous teeth have been supplanted by their permanent successors.

The permanent teeth are all larger than the corresponding ones of the deciduous set, with one exception,—the second bicuspid. This being the case, they require a larger alveolar arch and a correspondingly larger jaw bone for their accommodation. This nature furnishes by the slow process of enlargement by interstitial growth, which is hastened and stimulated by the lateral pressure of the teeth as they make their way into place, and afterward. When the first permanent molar makes its appearance it is obliged to provide sufficient accommodation for itself by forcing its way between the deciduous second molar and the strong maxillary tuberosity above or the equally resistant ramus below. This pressure is felt by all the other teeth in the arch. If, therefore, any of the deciduous molars should be extracted about the fifth or sixth year, for instance, as they too often are after having been impaired by disease, the permanent molar will move forward and occupy part of the space intended for the bicuspids.

When the permanent lower central incisors erupt they make their appearance inside of the deciduous ones, which soon loosen and drop out. Owing to the fact that the width of these new teeth is considerably greater than the space occupied by their predecessors, they naturally overlap to a certain extent the adjoining deciduous laterals. This overlapping prevents the centrals from moving forward into

line in the arch. When the permanent laterals erupt they assume a position by the side of the centrals, and to find accommodation in this contracted space inside of the arch several or all of them are apt to be crowded into irregular positions.

This condition, while perfectly natural, from the fact that these teeth have erupted too rapidly to admit of a corresponding increase in size of the alveolar arch, is often regarded as a serious evil, and to correct it, the inexperienced practitioner will in many cases extract the temporary cuspids which are designed for retention until years afterward. This additional space having been thus furnished, the permanent incisors will move forward into line and assume a regular position.

Later, when the bicuspids appear, they will usually find no difficulty in assuming places in the arch, because their predecessors occupied a larger space and because the cuspids are missing, but from the very abundance of the space and the pressure of the first molar from behind, the bicuspids will very soon, if not at once, be so pressed forward that the first bicuspid will be in contact with the lateral, leaving no space for the accommodation of the cuspid when it makes its appearance at about the eleventh or twelfth year.

Such being the case the cuspid must of necessity erupt outside or inside of the arch, and produce a deformity both unsightly and hard to correct.

Had the temporary cuspids not been extracted they would have preserved space for their successors, and the inlocked and irregular incisors, in the course of time, by the normal enlargement of the arch, and the excess provided by the removal of the deciduous molars, would have had space sufficient, which nature, assisted by the pressure of the tongue, would aid them in occupying.

The same condition is met with in the superior arch, perhaps more frequently than in the inferior. Here the incisors erupt outside of the deciduous ones, and sometimes appear

in an irregular and crowded position, to correct which the temporary cuspids are often needlessly sacrificed, and the same train of evils follows.

It will thus be seen that the premature extraction of any of the temporary teeth, especially the cuspids, cannot well result in other than harm to the permanent ones, so far as regularity is concerned.

Sir John Tomes relates a case in which he extracted for cause all of the deciduous teeth of a child, and yet when the permanent ones appeared they assumed their proper positions in the arch without any resultant irregularity.

This one case, however, the only one of the kind on record, does not disprove the facts as noticed in thousands of cases of opposite character, nor does it confute the plainly apparent workings of physiological law. It simply illustrates what nature may do in a single case under conditions exceptionally favorable.

INJUDICIOUS EXTRACTION OF PERMANENT TEETH.

A condition frequently met with after all the permanent teeth have been erupted, is one where in the upper jaw the centrals, bicuspids and molars are all harmoniously arranged, while the laterals occupy a position inside of the arch and the cuspids lie outside of it. The condition is most frequently brought about by the premature extraction of one or more members of the temporary set, as described under the last heading.

To remedy the difficulty in the easiest manner, some practitioners have at times extracted the laterals and on other occasions the cuspids. The result has been in each case an almost hopeless deformity. The cuspids brought next to the centrals oftentimes gives to the face a canine appearance, while with cuspids lacking the countenance is robbed of that prominence near the angles of the mouth so necessary to harmonious expression.

Again, the first permanent molars of one of the jaws are

often neglected until caries has made serious inroads upon them, when they are extracted as offending members. The result is that the lateral pressure, so necessary to proper expansion of the process is lacking in one jaw, while in the other the normal enlargement continues. As a consequence there is disparity of proportion between the two jaws, and the appearance of the individual is perhaps permanently marred.

DELAYED ERUPTION OF PERMANENT TEETH.

It sometimes happens, from causes not easily definable, that the eruption of one or more of the permanent teeth is retarded to such a degree that the rest of the set take positions in the arch and occupy all the space. When the tardy member is ready to erupt there is no place for it, and it is compelled to take a position outside or inside of the line. This is apt to occur more frequently with the cuspids than any of the other teeth, although it is occasionally met with in the case of the laterals and bicuspids.

ACCIDENTS.

An accidental injury to one or more of the teeth of either set, whether resulting in their loss or not, is often responsible for an irregular condition. Should a deciduous tooth become devitalized, as the result of an accident or other cause, and alveolar abscess supervene, the physiological act of absorption will be suspended, and the succeeding tooth in the course of its eruption will naturally be deflected from its course and erupt in an abnormal position.

So, also, it has happened that a deciduous incisor, through a fall, has been driven up into the process. Such a misfortune can hardly fail to cause an injury to the partially formed permanent tooth lying beneath it. Should no more serious result follow it will probably at least divert the course of the new tooth and be productive of an irregularity.

The author had one such case in his practice with an irregularly placed permanent tooth as the result.

HABITS.

The bad habits which young children are apt to acquire after they are weaned, such as thumb-, lip- or tongue-sucking are important factors in bringing about an irregular alignment of the teeth in one or more portions of the arch. Acquired early, while the temporary teeth are in position and firmly set, the habit will usually make no impression upon them, but if not checked and allowed to continue up to the time of the coming of the permanent set, as is frequently the case, these will generally be thrown out of position or be so altered in their relationship as to cause a serious deformity.

This is readily accounted for when we consider that the erupting teeth, seeking their position in the arch and surrounded by newly formed and pliable alveolar tissue, are easily turned out of their course by any extraneous force exerted upon them.

The general results of the triple habit are the same, although they vary in particulars. In thumb-sucking, usually only two or three of the incisors are pressed out of place, and the ones affected are determined by the hand used and the position of the thumb in the mouth. In lip- and tongue-sucking, owing to the larger surface of the organ employed, all of the incisors will be affected.

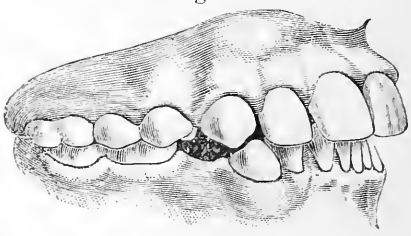
Not only has the point of introduction of the thumb to be considered in relation to its effects, but also the angle at which it is held. When the position of the thumb in relation to the teeth, forms less than a right angle, the upper teeth will be thrown out and the lower ones in; but when held in a horizontal position, the upper and lower teeth are not displaced but simply held apart. As a result of this latter position the first molars are kept from present contact and naturally elongate until in time they come together. The mouth is thus permanently propped apart in front and when the second molars erupt and come into occlusion the ill-condition is confirmed. With these eight firm teeth

in contact, there is no longer any hope of the ten anterior ones elongating sufficiently to meet, and we have the deformity known as "lack of anterior occlusion," which is not only a disfigurement but a serious disadvantage to the individual in mastication. This lack of anterior occlusion is not always due to the habit of thumb-sucking, for it may be brought about by physical peculiarities, as noticed in Part III., Chapter X.

In lip-sucking the lower lip is drawn into the mouth over the lower teeth, and held there for varying periods both day and night. The result is that by the force thus exerted the lower teeth are thrown in and the upper ones out to such an extent as to give them an unnatural prominence, and to cause spaces to exist between them.

Fig. 1 illustrates this condition. The child, when brought to the author for consultation, was twelve years of age and a confirmed victim to the habit of lip-sucking. All of the fourteen teeth in each jaw were fully erupted and nicely in line, except the eversion and introversion of the upper and lower incisor teeth respectively. The teeth were brought into proper position and the habit, by being thus made impossible, was broken up.

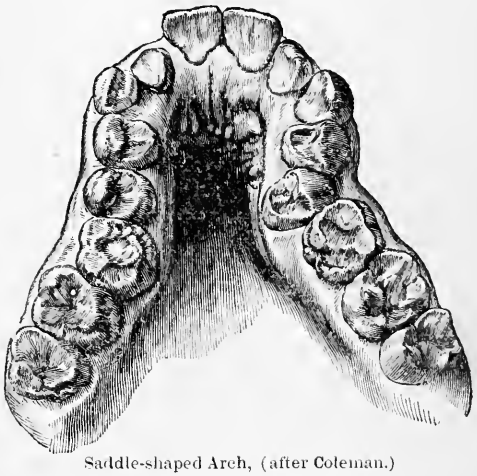
Fig. 1.



But the displacement and failure of occlusion of teeth in the anterior part of the mouth are, however, not the only evils associated with this habit in its three forms. In each case the jaws are held temporarily apart so that there could be no occlusion of the teeth even though they occluded normally when the jaws were closed. This leaves the side teeth free to change their position if any influence is exerted to produce that result. In the act of sucking, the cheeks are drawn in and the strong pressure thus brought to bear upon the

bicuspids and (occasionally) the first molars, causes them to be bent inward. In this mal-position they are frequently confirmed by the opportunity thus given the other molar teeth to move forward, of which they are not slow to take advantage. The result is the deformity known as the "saddle-shaped" jaw, as shown in Fig. 2.

Fig. 2.



Saddle-shaped Arch, (after Coleman.)

This deformity, produced by the same causes, may be present in the lower jaw, but it is much less frequently met with there than in the upper.

The condition may also be, and undoubtedly frequently is, due to other causes or conditions.

Mr. Charles Tomes ascribes the cause of this deformity, as well as that known as the "V-shaped arch," to enlarged tonsils, which by partially closing the posterior nares necessitates breathing with the mouth open. In this case as in lip-sucking, the jaws are kept apart and the contraction of the muscles of the cheeks has in consequence a tendency to deflect the bicuspids inward.

Irregular eruption of the permanent teeth is also a cause tending to bring about this condition. In some cases the cuspids erupt and assume their positions in the arch before one or both of the bicuspids make their appearance. When the latter erupt, there is insufficient space for their accommodation. Their effort to force themselves into position is met and opposed by the more firmly set cuspids and first molars, and in consequence they are forced to take a position

inside of the arch, making the diameter of the mouth at this point less than anywhere else, thus constituting a true saddle-shaped condition.

This deformity, according to the author's observation, is never inherited, but always acquired.

IRREGULARITIES OR DEFORMITIES WITH MIXED ETIOLOGICAL CHARACTERISTICS.

There are some typical malformations of the teeth and jaws the causes of which cannot be classed under either the hereditary or the acquired form, but combine certain features of both.

Among the more prominent of these are, protrusion of the upper jaw, prognathism, and the "V-shaped" arch.

SUPERIOR PROTRUSION.

In this condition the lower anterior teeth may be somewhat introverted or they may be in line forming their portion of a normal arch, while the superior ones project forward and outward to such an extent as to leave a space, more or less great, between their cutting edges and those of the lower, thus producing a marked deformity and giving to the individual a slightly imbecile expression. The lower anterior teeth, when the jaws are closed, may not occlude with their fellows above or they may rest in contact with the bases of their crowns instead of touching nearer the cutting edges.

In most cases this deformity is but the expression of a tendency inherited from a progenitor under conditions favorable to reproduction. It may also be, and in many cases doubtless is, the result of mechanical causes finding manifestation in the individual alone. Even if inherited it must have been the result of such causes in the individual with whom it originated.

In some instances we find it associated with abnormally large incisors, especially the centrals, which could find accom-

modation only by enlargement of the arch, while in others it bears evidence of being the result of an over-development of the superior or an under-development of the inferior arch.

It may also be caused by the mal-eruption of certain of the posterior teeth, permitting them to assume a position one tooth in advance of, or posterior to their normal place; such a condition would tend to restrain the lower teeth from pressing forward and cause the upper ones to advance unnaturally.

The condition also may appear exaggerated in cases where from some cause the lower incisors are inclined inward, thus causing the upper ones to seem more protruded than they really are.

PROGNATHISM.

This deformity, consisting in the abnormal protrusion of the inferior teeth and jaw, is one very frequently met with; it gives to the individual somewhat of a canine expression, and for this reason is very aptly designated by the Germans as Hundemaul. In some cases the lower anterior teeth antagonize with the superior ones but pass just outside of them, while in others the lower jaw and teeth are protruded to such an extent as to make the occlusion of the lower anterior and side teeth a physical impossibility. Fig. 3 represents an extreme case of this character. The deformity is not only very unsightly, but interferes seriously with mastication. It may be induced by any cause or causes that tend to lessen the extent of contact in occlusion. That the lower jaw possesses an inherent tendency to move forward when occlusion does not prevent is abundantly shown in cases where the

Fig. 3.

Excessive protrusion.

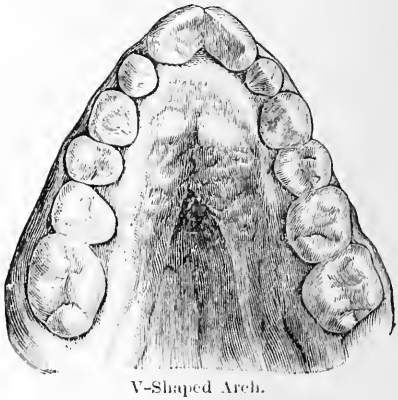
individual has become edentulous and no artificial teeth are worn. Even the occlusion of artificial teeth will lessen or check this tendency.

In many cases it is an undoubted inheritance, while in others it may be brought about by local conditions. It is liable to occur in all cases where it is not prevented by mechanical influences.

V-SHAPED ARCH.

The angular or V-shaped arch is not an uncommon one. In a typical arch of this character, the teeth instead of forming an arch, are arranged in two straight but divergent lines, which meet at an angle where the central incisors join each other. The molars, bicuspids and cuspids are usually properly related to one another, but simply thrown inward, forming straight lines instead of curves. The incisors, however, by this contraction of the space are not only thrown forward but turned upon their axes so that their lingual surfaces present toward each other. Fig. 4* represents this form of irregularity. It is in all cases confined to the superior maxilla, the lower one being usually harmonious in outline. The pressing forward of the incisor teeth and their torsion often gives such prominence to the lip that the teeth remain exposed even when the jaws are closed. In addition to this unsightliness, the speech is often seriously affected by the free and uncontrollable escape of air when articulation is attempted.

FIG. 4.



V-Shaped Arch.

The causes responsible for this condition are probably

* From a model in the collection of Dr. W. F. Fundenberg.

shrouded in greater obscurity than those of any other form of irregularity.

The crowding of teeth during eruption; delayed eruption; imperfect or excessive maxillary development or mal-occlusion; some of which are evidently responsible for many forms of irregularity, cannot be called to account for this condition, for none of them could press the teeth into such symmetrically straight lines. The most plausible hypothesis which has yet been advanced in regard to it is that of Mr. Charles Tomes, who believes that it is brought about by the pressure of the muscles of the cheeks upon the sides of the arch while sleeping with the mouth open, and that this habit is due to enlargement of the tonsils, which prevents full breathing through the nose.

The pressure of the cheeks covering so large a surface would be just the kind of force that would be likely to produce this symmetrical contraction of the arch, but the author's observation does not lead him to coincide with Mr. Tomes in the belief that it is usually associated with enlarged tonsils. Many persons breathe with their mouths open, and this habit, which may be due to a variety of causes, seems likely to be a factor in producing this peculiar condition; but the author believes that the deformity is one, the tendency to which is usually inherited.

CHAPTER III.

EVILS ASSOCIATED WITH IRREGULARITY.

In order to properly appreciate the importance of the correction of irregularity of the teeth, it will be well to consider in brief detail some of the more prominent evils associated with the condition.

APPEARANCE MARRED.

While this result is usually not the most important of those connected with irregularity, it is the one which most generally induces the patient to apply for remedial treatment. The other evils may not be recognized or may be considered of minor importance by the parent, but the ill-appearance of the child both attracts the attention and enlists the sympathy to such an extent as to create a desire for its improvement.

The external deformity caused by an irregularity will be greater or less according to its extent and location. If it be slight in character and located back of the cuspid teeth it will usually give no external evidence of its existence, but if located in the anterior part of the mouth, it will, even if slight, be very noticeable and in consequence constitute a source of annoyance to the individual throughout life.

The class of irregularities most noticeable under all conditions is that where the form of the arch is altered, thus changing in a marked degree the entire facial expression. Such deformity cannot be masked. It must either be mechanically reduced or stoically endured.

SPEECH AFFECTED.

This result like the preceding one will be slight or aggravated according to circumstances, but when at all considerable it proclaims itself to the world with every attempt at

speech in so unpleasant a manner as to be a painful annoyance to both speaker and listener.

It may be due to the restriction of the movements of the tongue as in a narrow or contracted arch, to alteration of the form of the roof or vault of the mouth where the sides of the latter have assumed a deep pitch resulting in the formation of a sharp angle along the median line of the palate, or, it may be, and most usually is, due to the uncontrollable escape of air between the teeth in the anterior part of the mouth by virtue of the non-approximation of those teeth and the change of form in that part of the alveolar ridge which aids the tongue in the production of perfect sounds.

MASTICATION IMPAIRED.

In most cases of irregularity, either simple or complicated, there is a corresponding degree of either mal-occlusion or lack of occlusion. In simple cases, or where but few teeth are thrown out of occlusion it may not occasion any inconvenience to the individual, but where the irregularity is at all extensive so many teeth are usually lacking in occlusion as to seriously impair the power of mastication.

When this latter condition prevails it is most likely to result, sooner or later, in injury to other organs, for where mastication is imperfectly performed greater demand is made upon the stomach to prepare the food for digestion and assimilation. The stomach soon feels the effect of this over-taxation and becomes weakened in tone, which may finally result in incapacitating it for the performance of its normal functions.

Teeth that do not occlude are of no use to the individual for purposes of mastication, and those that occlude but slightly or imperfectly possess very slight value.

As one of the principal functions of the teeth is mastication, and as all the teeth are needed to perform this work satisfactorily, it naturally follows that any interference with this function, through irregular position or otherwise, must

be detrimental to the individual and frequently result in partial or complete loss of health.

CARIES INDUCED.

The human teeth are arranged in the jaws in such manner as to best subserve the wants of the individual, and their form and location are also such as to conduce to the greatest immunity from caries and their consequent longest endurance.

Their rounded approximal surfaces and the constriction of their necks reduces the point of contact with their fellows to the minimum. As their liability to approximal decay is in proportion to the amount of surface in contact, it will be seen that those normally placed are likely to be freest from the ravages of caries.

When, therefore, the teeth occupy irregular positions, especially where they are crowded, more of the surface of each tooth is in contact, and the liability to decay is correspondingly increased. This is true of irregularly placed teeth in any part of the arch, but the liability is greatly increased where crowding or overlapping exists among the incisor teeth, for owing to their flattened form it is possible for more of their surface to be in contact with their fellows than would be possible with any of the other teeth.

In such cases, with the condition uncorrected, teeth decay and re-decay in spite of the most faithful efforts of the dentist until they are finally lost.

CHAPTER IV.

ADVISABILITY OF CORRECTION.

With our advanced knowledge in regard to the teeth and their surrounding tissues, and the advancement made of recent years in the multiplication and perfection of mechanical appliances, scarcely any deformity of the mouth and teeth is beyond mechanical remedy. With possibility assured, however, it is most important that we should consider carefully the question of advisability, for what is possible may not always be advisable. There are several considerations that enter into this question of advisability.

AGE.

The age of the patient has much to do with the advisability of any proposed operation for correction. Early in life, when the alveolar tissues have not yet reached the hardness and density of structure which they will attain at a later period, they are more easily operated upon. They are elastic and readily yield to pressure, and at the same time under the influence of this pressure they are more quickly resorbed and thus give way to the tooth that is being moved. This feature of early youth is an important and valuable one in that it renders an operation for correction more easy of accomplishment, but with it is also linked an element of adverse influence which must not be overlooked.

While the soft and easily yielding process favors the operation, it is at the same time a tissue poorly fitted to resist the influences which often operate to again displace the tooth. For this reason, a tooth moved at an early age is often liable to subsequent displacement when the pressure caused by the eruption of the succeeding teeth is brought to bear upon it.

After maturity, we have the conditions exactly reversed. The denser and more perfectly calcified process yields less readily to pressure and absorption, but when the tooth has once been moved into proper position it is more easily and firmly held there by the surrounding tissues.

In view of these facts it will readily be seen that in many cases, especially where the proposed operation is simple in character, and where the result obtained is not likely to be nullified by subsequent events, interference early in life is advisable, but where the operation is to be extensive in character and the result difficult to secure against subsequent adverse influences (such as the eruption of the later teeth) prudence would suggest non-interference until all of the fourteen teeth of the involved jaw have erupted.

HEALTH.

The health and strength of the patient at the time of any proposed operation for irregularity is so important a consideration that it must not be disregarded. The time that is generally considered most favorable for correction (between the ages of thirteen and eighteen years) is also a period when important changes are going on in the entire economy. The individual is passing from the stage of childhood into that of manhood or womanhood, and in this change, especially in the case of the female, the life-forces are taxed to the utmost. At this time also the mental faculties are being severely strained by study, in consequence of which, if the physical culture of the individual be neglected, as it too often is, the nervous system becomes unduly exalted.

To meet and partially compensate for these drains upon the system it is most important that full nutrition be sustained. To do this with teeth that are sore or tender to the touch from being moved is impossible, and hence the system will be still further weakened by lack of nourishment if any severe operation be undertaken.

At this period of life, therefore, unless the patient possesses

vital powers of a high order, it might be unwise to further tax his or her system by any extensive operation for correction that would involve the infliction of much pain, discomfort or annoyance. Should the vitality of the patient be below the average, no difficult or protracted operation for correction should be undertaken, for it might result in permanent impairment of the health.

It is much better to postpone the operation until a time when the vital powers can stand the strain, or if necessary abandon it altogether, for the loss of health can never be compensated for by any benefit conferred upon the dental organs.

SEX.

The sex of the individual must also be considered in connection with this subject. The consideration of sex may be disregarded so far as the desirability of an operation is concerned—for if the results of neglected irregularity are harmful in respect to one sex, they are certainly equally so in regard to the other—but as regards the necessity for interference the question of sex is an important one. Correct facial expression and harmony of feature are far more important to the female than to the male; for, being endowed by Nature with greater beauty of form and feature than man, its absence in any part is more noticeable than it would be in the sterner sex. Besides this, after youth is passed, man has in the hairy covering of the lip a means of concealing most deformities of the dental arch, while woman is entirely without this advantage. For these reasons the necessity for the correction of any irregularity of the teeth seems more imperative in woman than in man.

POWER OF APPRECIATION.

The intelligence of the patient and his ability to properly appreciate any benefit conferred, are important considerations in enabling us to determine whether or not to undertake any considerable operation for the correction of irregularity.

Orthodontia, at best, is a most difficult undertaking, and frequently lacking in suitable pecuniary reward, so that the lover of the art must nearly always depend upon appreciation for part of his compensation. If this be wanting, the operation is robbed of nearly or quite all of its attractiveness, and the stimulus to success is absent.

There are those whose want of intelligence or lack of culture would lead them to regard with much indifference any irregularity of their teeth, and who if they were benefited by our efforts for correction would fail to appreciate the benefit conferred. For such it would be manifestly unwise to urge or encourage any difficult or extensive operation for correction even though they might be able to compensate us pecuniarily for our labor, for they would be likely either to give up the operation when partially completed or fail to wear any appliance for retention, and thus permit failure to follow success.

FAMILY TYPE.

When any great deformity of the teeth and jaws, such as anterior protrusion of either jaw or a V-shaped arch is shown to be hereditary, it is well to take into consideration the hereditary feature of the case before beginning any operation for correction. Where the irregularity is known to have been acquired in the parent of the child and thus to have been transmitted but once, the difficulties in the case are not so marked because the type has scarcely been confirmed; but where it has been transmitted through two or more generations the impress is strong and difficult to overcome.

In the latter case the correction of the deformity will not be more difficult than usual, but after correction the tendency of perverted nature to cause a return to the family type will be so strong as to almost baffle us in our attempts to preserve the advantage we have gained. Under such circumstances the retaining appliance will have to be worn a very long time, and a constant watch kept over the case until we are sure that the result will be permanent.

CHAPTER V.

AGE AT WHICH CORRECTION MAY BE BEGUN.

The correction of irregularities, under favoring conditions, may be begun and carried forward successfully through a wide range of years.

It may be undertaken as early as the eighth or ninth year, and again may yield successful results as late as the thirty-fifth year or later. The operation is one largely dependent upon the absorption and re-formation of bone, and as new bone will form at almost any period of life, as evidenced by the reunion of a fracture, so the correction of an irregularity is possible at quite a late period.

The correction of irregularity, however, would usually prove so slow and tedious an operation after the maximum of density had been attained in the process, and the necessity for it be so much lessened by advancing age, that the advisability of undertaking it would be questionable.

The most favorable time for correction in cases as they usually present is between the ages of thirteen and eighteen. Earlier than this the operation is advisable under certain circumstances, and later the difficulties increase with the years.

WHEN EARLY INTERFERENCE IS JUSTIFIABLE AND ADVISABLE.

Any of the permanent teeth may erupt outside or inside of the arch. If allowed to remain in such position for any length of time, the space intended for their accommodation will soon be partly occupied by the adjoining teeth, and the subsequent correction of the irregularity rendered more difficult. So also a central or lateral incisor often erupts in such manner that its cutting edge, instead of being in line with the curve of the arch, forms an angle with it.

This torsion may be associated with an overlapping of the adjacent tooth as shown in Fig. 5, or there may be a space between the two as shown in Fig. 6.

FIG. 5.

Torsion and Overlapping.

FIG. 6.

Torsion with Space.

In either case the twisted tooth occupies a less space at the line of the cutting edge than it should. By allowing this condition to remain, when the pressure of the later erupting teeth begins to be felt, these teeth will be pressed still closer together and the irregularity be confirmed. Subsequently, when the correction of the condition is attempted, there will not be sufficient room to accommodate the tooth in its wider aspect and the adjoining teeth will have to be pressed apart or the arch expanded to obtain the necessary room; while, if the tooth had been turned in its socket before the eruption of the other teeth the operation would have been a very simple one.

Again, when an incisor erupts so as to occupy a position inside of the arch in the upper jaw, or outside of it in the lower, and the tooth be held in such position by the antagonizing teeth, immediate interference and correction is demanded in order to prevent the complications that would result from the partial or complete closure of the space intended for the accommodation of the malposed tooth. The superior central incisors sometimes erupt in such a manner that their cutting edges form an angle at the median line. To neglect the condition or to postpone its correction will not only result in its confirmation and probable aggravation, but may also open the way for a complete change in the shape of the arch.

It is entirely probable that certain arches of a modified V-shape have been formed in this way. In cases such as those just mentioned, early interference is the wiser plan, but it is equally important that after they have been placed

properly in line they should be firmly held, not only until new bony tissue has been formed around them, but until the lateral pressure of the neighboring teeth coming into place has spent itself.

How this may be readily and successfully done will appear in the consideration of practical cases in Part III.

In the lower jaw the conditions are somewhat different. The incisors, upon eruption, generally present a somewhat crowded and irregular condition, which is partly or entirely corrected by nature in the enlargement of the arch and the influence of the lip and tongue in bringing them into a more harmonious outline.

Interference with them is not called for, if at all, until a later period.

At best, the attempt to correct an irregularity during the earlier period of permanent dentition should usually be confined to one or two teeth; if anything more extensive is called for, it should be delayed.

WHEN CORRECTION SHOULD BE DELAYED UNTIL DENTITION IS COMPLETE.

As a rule, any extensive operation for the correction of irregularity involving a number of teeth, should not be undertaken until all of the permanent teeth (excepting the third molars) are fully erupted. When a single incisor is malposed with no prospect of its being able to take its place in the arch unaided, and every prospect of its being confirmed in its malposition, the necessity for immediate interference is plainly evident; but, where a number of teeth are malposed it is not so easy to prognosticate what effect their correction may have when considered in relation to the teeth still to be erupted. The result is naturally involved in some doubt. Even if the necessity for correction appears evident to us and we should accomplish it, the result may be wholly undone by later influences which could not have been foreseen.

Under such circumstances it is wise to delay interference until the permanent teeth are in place and the arch fully expanded, when by a careful examination of all the conditions we can easily foresee the result of any proposed operation and decide intelligently not only what needs to be done, but also the best way of accomplishing the desired result. Oftentimes this later examination will show that the irregularity has much improved and the necessity for interference is consequently lessened.

The line of distinction between the advisability of early and late interference is plainly marked and should not be lost sight of, for a mistake in either case would necessarily bring about unfortunate results.

CHAPTER VI.

MOVEMENTS TO BE PRODUCED AND PRINCIPLES GOVERNING THE APPLICATION OF FORCE.

In causing malposed teeth to assume their proper positions in the arch certain movements are necessary, and to properly accomplish them forces must be brought to bear in a manner best calculated to produce the desired result. The usual movements that teeth undergo in being forced into position, are outward, inward, forward, backward and rotary. Sometimes but one movement is necessary in the case of a single tooth, but more frequently several are required before proper alignment is secured.

The application and regulation of force in producing movements of the teeth are governed largely by the general principles of applied mechanics.

The greatest good can be obtained from any force only when it is exerted in a direct line with the movement desired.

To this end, in the selection or application of any devices for the moving of teeth, preference should be given, *cæteris paribus*, to those that are most direct in their action.

The application of direct force, however, is not always possible owing to the position the power-producing instrument would have to occupy in the mouth, and the consequent interference (as in the lower jaw) it would cause in limiting the movements of the surrounding or adjacent organs. For this reason we very frequently have to consent to the use of some form of appliance that will yield power in a line that is not direct, but still effective.

The force used must be sufficient, but not excessive, and not too abruptly applied.

If the force be insufficient to accomplish the desired object the result would not only be a failure but it would also

involve a serious waste of the time of both patient and operator; whereas, if it were more than sufficient it might cause a fracture of one of the alveolar plates, a rupture of a blood-vessel at the apical foramen, or a constriction of the entire pulp at the same point, resulting in its devitalization.

So, also, in the widening of the arch: if the force be too great or too suddenly applied it is liable to result in the separation of the superior maxillary bones at the palatal suture. The greatest prudence and care are necessary in the application of force to the teeth.

The points of resistance and delivery of the force must be fixed points.

The point of resistance, or in other words the point selected to resist the strain of an appliance while it is being exerted to cause movement at some other point, must necessarily be fixed and immovable, for if it be not so, fully one half or more of the force expended will be lost. Not only this, but if the anchor tooth or teeth should yield at all to the pressure they would be pressed out of place and thus one irregularity would be created in our attempt to correct another.

No factor in orthodontia is more important than this.

So, also, the point of delivery must be a fixed point. By a fixed point in this sense, is meant one that will receive the force in such a way that none of it will be lost. As the intended tooth is moved, the point on its surface where the force is delivered will necessarily move with it, but it should be so arranged that in this movement the point of delivery be not changed. A change at this point will be as disastrous, and frequently more so, than at the point of resistance, for if the appliance slip or change its position, the force will be exerted in a line different from that intended and harm will always result.

Great difficulty was formerly experienced in making attachments for appliances so that they might be immovably

held where placed, but since the introduction of the platinum band by Dr. Magill, difficulty of this character has been overcome.

The resistance at the point from which we exert pressure, must be greater than the resistance to be overcome by the pressure.

The truth and importance of this statement would seem to be self-evident.

Our points of resistance usually consist of one or more teeth situated at some distance from the one intended to be moved. Occasionally, a single tooth, if it be multi-rooted or one with a long root firmly implanted, will be sufficient for our anchorage, provided the tooth to be moved be single-rooted and of not too great resisting power; but a tooth with a single root will seldom be sufficient for anchorage in moving any other tooth. A single molar, firmly implanted, may sometimes be sufficient to offer resistance in the moving of a bicuspid or incisor, but it is always better, if possible, to have the resistance divided among several teeth.

A cuspid should never be depended upon to resist alone the force needed to move another cuspid, for it is as likely that the one will be moved out of as the other into place. The force of resistance should always be as much distributed as possible, for the sake of safety.

It should always be seen to, in advance, that there is sufficient space to accommodate the tooth in the new position it is to occupy.

The importance of this precautionary measure will be readily seen. Unless there be room to accommodate a tooth we will either fail in our efforts to move it or succeed only by the expenditure of an amount of force out of all proportion to the requirements of the case. Instead of moving one tooth we may under such circumstances have to move several at the same time, a difficult and oftentimes unnecessary undertaking.

If sufficient room does not exist naturally, we can increase

it by separating the adjoining teeth. If the space already existing be too great to admit of the use of rubber wedges, the object can be accomplished by the use of wood, or other suitable substance.

The method advocated by one writer to accomplish this result by means of a double-ended screw with face-clamps, is both unnecessarily complicated and less efficient.

In many cases where a tooth is locked out of place the jaw needs or will bear expansion as well. In such cases, of course, we expand the arch first, and this will afford us room to bring the tooth into position.

An exception to this rule is sometimes found in the case of a lower incisor placed slightly within the arch and held there by the adjoining teeth. As these teeth are usually easily moved it will not be necessary to provide room in advance, for, if our point of resistance be sufficient, we can, by the use of a jack-screw, readily force the tooth into line, notwithstanding the overlapping of adjoining teeth. An illustration of this method is shown in Fig. 11, p. 64.

Pressure may be either constant or interrupted.

The question of the use of either constant or interrupted pressure in the regulation of teeth did not arise until Dr. Farrar declared, a number of years ago, that, according to physiological law, direct and intermittent pressure was the only kind suitable to be applied in the moving of teeth.

The only way in which direct and intermittent force can be applied is by the use of the screw in one of its various forms. Continuous pressure is that which we obtain from the elasticity of the metals, from rubber, either partially or fully vulcanized, and from the expansion of wood, sea-tangle or other like substances. The action of these substances cannot well be interrupted to provide a period of rest, but they continue their action until the force they are designed to exert has been spent.

The screw is, in many cases, one of the best methods by

which to exert pressure, but it cannot be applied to advantage in all cases. To limit ourselves therefore to its use, would be to deny ourselves the advantage to be gained by the employment of the various substances previously enumerated.

So far as the author is aware no one has advocated the exclusive use of constant pressure, but those who believe in and make use of it, also use the interrupted pressure in the form of the screw, not because of its interruptability but because of its directness and power.

Experience has shown that by continuous pressure equally good results have been produced as by uninterrupted pressure and with as little harm. Those who, like the author, have used both kinds according to the seeming requirements of the case in hand, have been unable to notice any advantage in the one over the other as viewed from a physiological standpoint.

Dr. Atkinson has recently expressed his belief that continuous pressure in regulating most fully stimulates the action of the osteoclasts in the absorption of alveolar tissue.

Pressure should be exerted as nearly as possible in a line at right angles to the long axis of the tooth.

By the application of power in this way the best results are accomplished. If the power be applied at a slight angle from above, no harm will result, as it will only serve to keep the tooth in its socket while it is being moved, but if applied at an angle from below, the tendency will be to lift the tooth from its socket and serious complications may ensue.

This last result is most liable to follow the use of a jack-screw applied at an improper angle, when by its direct and excessive power the tooth may be lifted up and partially dislodged.

CHAPTER VII.

EXTRACTION AS RELATED TO ORTHODONTIA.

Probably no feature in the practice of Orthodontia is more important, or has associated with it greater possibilities for good or evil to the patient than that of extraction.

As related to the prevention or correction of irregularity, extraction on the one hand may be of the greatest possible benefit or on the other it may result in irreparable injury.

Judicious extraction, if undertaken in time, will often forestall or prevent an irregular condition of the teeth, and in other cases it will assist greatly in simplifying the operation of correction. Occasionally, it is all that is called for on our part, nature performing the rest of the operation unaided.

Injudicious or ill-advised extraction, however, may complicate and render most difficult the correction of cases which in themselves were not difficult, or it may even be the immediate cause of a deformity which would not otherwise have existed.

The paramount importance, therefore, of knowing when to extract, and when not, will be readily recognized.

To properly convey to the student a fair understanding of these circumstances, in as concise and comprehensive a manner as possible, it has been thought best to formulate the following rules:

Always avoid, if possible, extracting any of the six anterior teeth in the superior arch.

We would urge this, because it is nearly always unnecessary to extract them, and because their absence, owing to their prominent position, would be more noticeable than that of other teeth in the mouth. If the anterior teeth

be sound and only irregular in position, the extraction of a bicuspid from one or both sides will usually give us sufficient room for spreading the anterior teeth and moving them into their proper positions.

It has happened, however, to the author and others, to meet with cases where the superior laterals were locked inside of the arch by the close approximation of centrals and cuspids, and where the laterals were withal so badly injured by decay and disease as to render their usefulness doubtful if brought into line. In such few cases it was deemed best to extract the laterals, especially as their absence would not be more noticeable afterward than before, and because there was good occlusion between the rest of the teeth in the mouth.

The author had two cases in one year present to him for the reduction of protrusion in the anterior superior teeth. In each case there was a broken or badly diseased right central incisor that was beyond hope of preservation. In these cases it did not happen particularly amiss, for the extraction of the roots afforded room for drawing in the remaining five teeth, thus easily reducing the deformity and at the same time closing the space. The appearance of the patient in each instance was greatly improved, and the absence of even so large a tooth as the central was scarcely noticeable.

In the cases just mentioned it must be borne in mind that advantage was simply taken of an existing condition to simplify an operation. Had the teeth been good, it would have been criminal to extract them.

In another case, a girl eleven years of age had lost a right superior central incisor through a fall from a swing. Two days after the accident, and when the tooth had been mislaid or thrown away, she was brought for treatment. Only two methods of remedying the difficulty suggested themselves. One was the wearing of an artificial tooth; the other, drawing the teeth together to close the space. The latter plan was decided upon, and successfully carried into effect; but,

unfortunately, as there had been no protrusion before and there was contraction afterward, the superior teeth no longer overlapped the lower ones, but met them edge to edge, thus giving the upper jaw a flattened appearance, which was in itself a deformity. The patient was saved the annoyance of wearing an artificial tooth, but her facial expression was injured in consequence.

Such cases as those just alluded to are exceedingly rare, and are only mentioned as extraordinary exceptions to a very good rule. Aside from the centrals, there is probably less excuse for the extraction of the cuspids, than any of the anterior teeth, and yet it is, unfortunately, too often resorted to.

If for any cause, the cuspids erupt abnormally, and there is no room for them in the arch, if it be not advisable to expand the arch, one of the bicuspids on each side should be extracted to make room for them. The cuspid being the stronger and more durable tooth of the two, it should be given the preference in the struggle for existence. More than this, owing to its long and prominent root it gives a characteristic expression to the face, and if it be lost the expression will be irretrievably lost with it. The first bicuspid proves a very poor substitute for it in every way.

In the lower jaw one of the incisors may sometimes be extracted to gain space.

Slight irregularity or crowding of the inferior incisors is of such common occurrence as to have almost become the rule instead of the exception. Their partial concealment, together with the usual freedom of the condition from ill results, causes any interference to seem meddlesome rather than otherwise, if the irregularity be trifling. In cases, however, where the crowding is excessive and calls for correction, it is usually the easier and better plan to extract one of the implicated teeth and bring the others together into line. The four teeth are so nearly alike in size and charac-

ter, that the loss is not usually noticed when one has been removed. It is sometimes perplexing to decide which of the four to extract, but the one most out of line, and in consequence the one that will create the least space by its removal, should usually be selected.

In respect to the loss of the inferior cuspid, the same remarks apply as to its fellow in the opposite jaw.

Back of the anterior teeth, if all are equally good and one must be removed, select the one nearest and posterior to the one out of position.

As so large a proportion of the irregularities we are called upon to correct pertain to the anterior teeth, and as it is so advisable to retain these, extraction for room, when necessary, generally falls upon one of the teeth posterior to the cuspids. Which of these it is best to extract, to make room for a malposed cuspid or incisor, has been a subject of controversy among practitioners for many years.

Some have claimed that as the statistical tables show the first molar to be by far the least durable of all the permanent teeth, it should generally be selected as the one to be sacrificed. Others, on the contrary, have contended that as the first and second bicuspids are both frail teeth, and are often lost early in life, and as from its greater size the first molar is so much more valuable in mastication, it should be preserved and one of the bicuspids removed.

There is truth in both of these arguments, but we feel satisfied that under the conditions named, all equally good at the time, wisdom will dictate the removal of the one nearest the point of difficulty, for in so doing we greatly simplify the operation for correction and effect a saving all around. Simplicity in surgical as well as mechanical matters is a great desideratum. Indeed, it not infrequently happens that where a cuspid is out of line the first bicuspid assumes its place in the arch, so that if we were to extract the first molar, both first and second bicuspids would have to be

moved out of their position of good occlusion into a space further back, a feat very difficult and oftentimes well-nigh impossible of accomplishment. By the simple extraction of the first bicuspid in such cases, the cuspid will usually fall into its place without any assistance.

If a tooth other than the one nearest to that in malposition be defective, and not too far distant from point of irregularity, extract it instead.

The second molar, decayed or sound, is usually too far distant to be available by its extraction in furnishing room for the movement of anterior teeth. If the bicuspids be sound and the occlusion does not interfere with their backward movement, the first molar, if very defective, may be extracted in preference to a sound tooth in advance of it.

So, too, if the second bicuspid be carious or defective and the first one healthy, the former should for the same reason be extracted.

If a tooth must be lost, either to allow a more important one to fall into line or to create space, it should be done without delay to accomplish the best results.

When a cuspid erupts without room in the arch for its accommodation, and the circumstances of the case point to the extraction of the first bicuspid to make place for it, the sooner the extraction takes place the better. If the operation be delayed, the cuspid in its endeavor to force its way into place will often press so hard upon the lateral as to force it inward, and if possible under the central, thus creating an additional irregularity. Such results have often been noticed. Prompt extraction after it had become necessary would have changed the condition.

In similar manner, when it becomes advisable to extract one or more of the first molars to prevent the further expansion of the jaw or to abort a threatened irregularity in the anterior part of the arch, it is best not to delay their extrac-

tion too long. They should not be extracted before the second bicuspids are in place, but if they must be lost, they should be removed after the eruption of the latter teeth and before the second molars appear, somewhere about the eleventh or twelfth year. If longer delayed the harm we wished to prevent (expansion of the jaw) will have been accomplished and their later extraction will not avail. If extracted about the time the second molars are erupting, the latter will glide naturally into the space formerly occupied by the extracted teeth; this they are not so apt to do later on.

If a tooth must be removed on one side to obtain space it does not necessarily follow that its mate on the opposite side should also be extracted.

If there be the same reason for extracting both, as where the existing evil pertains as much to one side as to the other, let both be extracted; but where the trouble sought to be remedied is confined to one side, the extraction of a tooth on that side ought not to be supplemented by a useless extraction on the other. Those who favor symmetrical or double extraction claim that it prevents the disturbance of the median line, but it has been our experience that the extraction of a tooth back of the cuspid will not often affect the central line through the moving of the teeth toward the space, and even a slight disturbance of that line is far less objectionable than the sacrifice of a valuable tooth.

Where there is disparity in size between the two jaws, and two teeth need to be extracted from the more prominent one, it would be a serious mistake to extract also the corresponding teeth in the other and smaller jaw.

It would seem almost impossible to make such a mistake, and yet that it has been made time and again, the mouths we are called upon to examine often bear sad evidence. It

occurs through lack of knowledge, want of judgment, or erroneous teaching.

When those of long practice advise, without qualification, that at eleven years of age the four first molars should be extracted, it is scarcely to be wondered at that some young practitioners should lose confidence in their own better judgment and be led astray. Harm of this nature, when once done, can never be undone, and the patient is injured beyond repair.

Needless extraction should be carefully guarded against.

It is our object to save and improve, not to destroy. Extraction should only be resorted to when it appears, after careful consideration, to be the only or best way of accomplishing the object in view. Ill-advised extraction of the molars or bicuspids has often been the cause of a very serious and irremediable form of deformity, namely:—the separation of the anterior teeth from one another, leaving unsightly spaces between them, thus depriving them of their natural support and leading to their earlier loss.

When teeth, especially the first molars, are extracted at a later period than they should be, leaving a space that the second molars cannot occupy, the teeth anterior to the space will fall back unless prevented by the occlusion. If this falling back pertains only to the bicuspids, no harm will usually result, but if it extends to the anterior teeth, as it may and often does, the result will be disastrous. In this connection we cannot help again emphasizing the necessity for the removal of first molars (if they are to be removed) before the second molars have assumed their places in the arch.

If a crowded arch calls for or will admit of expansion to advantage, do this in preference to extracting.

CHAPTER VIII.

PHYSIOLOGY OF TOOTH-MOVEMENT AND CHARACTER OF TISSUES INVOLVED.

In changing the position of teeth in the act of regulating, the surrounding tissues, both hard and soft, are largely involved.

In order therefore to properly comprehend the philosophy of tooth movement, it is necessary to understand the structural character of these tissues and the physiological changes that take place in them while a tooth is being moved.

THE ALVEOLAR PROCESS.

This process, as its name implies, is not a separate and distinct bone, but an outgrowth from another. It is a provisional structure designed to support the teeth in position and afford lodgement for the nutrient vessels leading to them. It is formed upon the body of the bones of the jaw as the teeth are developed, growing with them until they are fully formed and then remaining while they remain.

When the teeth are lost, there being no longer any special use for it, most of this process is absorbed and carried away. In early infancy little alveolar structure exists, but it is formed co-ordinately with the growth of the deciduous teeth and remains during the period of their retention. Should they be lost before their successors are ready to appear, the process will be entirely removed by absorption, and a new one be formed for the accommodation of the permanent teeth. Where, however, the deciduous teeth are gradually shed to make way for their successors, the process is not entirely absorbed, the basal and unabsorbed portion serving as a foundation upon which the new structure is formed.

The alveolar process, being built or formed upon the body of the maxillary bones, conforms to them in outline and

describes the same curves. In depth it corresponds to the length of the roots of the teeth, while in width it is sufficient to envelop all of that portion of the teeth located below the gum line. It gradually increases in width as it approaches the body of the bone upon which it rests.

It consists of an outer and inner plate united at intervals by septa, thus forming the alveoli for the accommodation of the roots of the teeth. In structure, the process is not compact, but open and spongy, somewhat resembling the cancellated structure of the diploe of the bones of the cranium or the inner portion of the shafts of the long bones. Its outer or cortical layer is denser and harder than the inner portion. Its cellular structure, while giving it sufficient firmness to support the teeth in their positions, affords opportunity for the lodgement and passage of the vessels of nutrition with which it is so bountifully supplied.

Owing to its peculiar structure and its great vascularity, it is readily resorbed under the stimulus of pressure and again readily reproduced behind the moving teeth.

THE TEETH.

Of the teeth themselves, but little need be said. The student is familiar with their number, shape, position and structure. Being the hardest structures of the human body, the application of any force necessary to move them will not injuriously affect them so far as their hard tissues are concerned.

A mechanical difficulty associated with their moving consists in the fact that their crowns are round and smooth, thus making it somewhat difficult to apply force at a given point. This difficulty, however, has been overcome by the introduction of the Magill band.

In considering the moving of teeth, the fact must not be overlooked that while the crown may be moved considerably, the movement becomes less and less along the line of the root so that the apex is moved but little. This is due to the

fact that force can only be applied to the crown, while the apex remains almost a fixed point or fulcrum. In the movement of a tooth therefore, whether inward or outward, forward or backward, the crown describes the arc of a circle, the centre of which is near the apex of the root.

Teeth with single and short roots can be moved more readily than those with long and many roots, for the reason that in the former case there will be less resistance to be overcome.

THE PULP.

The pulp is the formative organ of the tooth, and after calcification is complete it remains as the principal source of nutrient supply for the dental tissues, especially the dentine.

It is composed of fibrous connective tissue, containing a delicate system of lymphatics, together with numerous nerve filaments which enter through the apical foramen. Ramifications of minute blood-vessels are noticeable throughout its whole extent, giving color to the organ and constituting its vascular system.

It bears an important relation to the teeth in their movement since it may be readily devitalized through imprudence or lack of care. Before calcification of the teeth has been completed the apical foramen is large and easily accommodates the pulp where it enters the tooth. After calcification is complete the apical foramen is small, and the pulp at this point is in consequence greatly reduced in size. In the movement of the teeth there is often a slight mechanical constriction of the pulp at the apex due to the tipping of the tooth in moving. If the movement be rapid in teeth fully calcified (after the sixteenth or eighteenth year) this constriction may be so great as to cause the death of the pulp through strangulation. Before complete calcification this is not likely to occur, from the fact that when the foramen is large the pulp has more space for its accommodation.

In the movement of a tooth in the direction of its length the pulp may also become devitalized through excessive

stretching. This has occurred at times in drawing down into line a tooth that has been retarded in eruption. In all such cases care must be exercised and the movement be conducted slowly.

THE PERICEMENTUM.

The pericementum or peridental membrane is that tissue which envelops the root of the tooth and fills the space intervening between it and the alveolar wall. It is a tough, strong membrane, composed mainly of fibrous connective tissue, permeated with blood vessels and nerve fibres and containing traces of a lymphatic system.

It is strongly adherent to the alveolar wall of the socket on the one hand and to the cementum of the tooth on the other, its adherence being due to the extension of its fibres into both the bone and the cementum. These fibres, according to Prof. Black,* "are wholly of the white or inelastic connective tissue variety," and the apparent elasticity of the membrane is due to the passage of most of the fibres from cementum to wall in an oblique direction, in such a way as to "swing the tooth in its socket."

This membrane is the formative organ of the cementum of the tooth and also assists in building the walls of the alveoli.

The cells concerned in the building of the bony walls are known as osteoblasts, and those forming the cementum are designated cementoblasts. After these cells have performed their normal function, they become encapsuled and form part of the tissue they were instrumental in building.

When re-formation of tissue is demanded, as in the thickening of the alveolar wall, or in enlarging the normal amount of cementum at various points under certain conditions, new cells are originated to perform the work. In the moving of a tooth the activity of these new cells is at once manifested in the formation of alveolar tissue to fill the space caused by the advancing tooth.

*Dental Review, vol. I., p. 240.

Beside these cells of construction and repair, the pericementum also contains cells that might well be called *cells of destruction*. They are the osteoclasts or cementoclasts, and their function is to break down or absorb the cemental or osseous tissues when nature calls for such action.

In the correction of irregularities, these cells perform valuable service in removing bony tissue in front of the moving tooth.

The pericementum is thickest in childhood, when the sockets or alveoli are of necessity considerably larger than the roots of the teeth which they contain. With advancing age both cementum and the alveolar walls are increased in thickness by slow but continuous growth until the pericementum is greatly reduced in thickness, and in consequence the diameter of the roots more nearly approximates that of the alveoli or sockets.

The pericementum possesses a variety of function not often met with in any single tissue of the human system.

It retains the tooth in its socket and acts as a cushion to prevent injury to the adjoining bony structures from hard and violent concussions to which the teeth are sometimes subjected.

It affords accommodation for numerous blood-vessels which supply both the teeth and alveolar tissue with nutrient material, and for the branches of nerves which constitute it the sensory organ of the tooth, so far as tactual impress is concerned.

It is the organ of construction and repair of both cementum and bone, and is also, on occasion, the organ of destruction of either or both of these tissues.

Its great importance in the moving of teeth is shown in the fact that without its services teeth could not be altered in their positions without serious injury to themselves or adjoining parts, and if so moved would be useless, because they could not possibly be made firm in their new positions. In

other words, the regulation of teeth would be a physical impossibility without the important services rendered by this peridental membrane.

PHYSIOLOGICAL ACTION IN THE MOVEMENT OF A TOOTH.

When force is exerted upon a tooth for the purpose of moving it, the first effect produced is the compression of the pericementum between the tooth and alveolar wall on the advancing side, and the stretching of the same membrane on the opposite side. In the compression of the membrane, the blood supply is partly cut off and the nerves, by their irritation, create a sensation of pain, which is soon obliterated by the semi-paralysis brought about by continued pressure. At the same time this irritation stimulates and hastens the development of the osteoclasts which at once begin the work of breaking down and absorbing that portion of the socket pressed upon.

Bony tissue being thus removed, accommodation is made for the advancement of the tooth, which at once takes place. Under continued pressure this action is renewed again and again until the tooth has reached its intended position. While this is taking place on the advancing side, quite an opposite condition prevails on the side from which advancement has taken place. There the fibrous tissue of the pericementum has been subjected to extreme tension; greater room has been provided for the accommodation of the nutrient vessels, and osteoblasts have been developed for the formation of bony material to add to the alveolar wall and thus close the space caused by the movement of the tooth. While these processes of absorption and reproduction on opposite sides of the tooth have been going on coincidently, their results have been very unequal, for the absorption of bone is a far more rapid process than its formation.

During the entire time of moving and for a long time afterward, the tension of the pericementum on the free side of the tooth is kept up to such an extent that were the force

of pressure or retention removed, the tooth would at once be drawn partly back into the space created by its movement.

The tendency is only finally overcome after the deposit of ossific matter in the alveolar socket has been sufficient to allow the pericementum to resume its normal thickness on that side of the tooth, when, by virtue of the removal of the tension and the support of the new bony tissue, the backward movement of the teeth will no longer be possible.

While this process of reparative construction has been going on, the structures about the opposite side of the tooth have been adjusting themselves to the new condition. The pressure upon the tooth having ceased, no more bone is absorbed; any injury inflicted upon the pericementum by its continued compression is repaired; the nerves and blood-vessels resume their normal functions and the tooth in its new position becomes a far more useful member of the dental organism than it had been.

PART II.

CHAPTER I.

MATERIALS AND METHODS.

EXAMINATION OF THE MOUTH.

When a case of irregularity presents for treatment, the first requirement is a careful examination of the mouth and teeth.

In conducting this examination it is necessary to note the position of the teeth; their relation to one another; their occlusion with those of the opposite jaw; the relative size and shape of both arches; the size, character and condition of the teeth; the age and general health of the patient; the harmony or inharmony of the features and the facial expression.

A careful consideration of all these points will enable us to decide:—

1st. What is desirable.

2nd. Whether it can be done.

3rd. If possible, how it can best be accomplished.

After this preliminary examination, our opinion of the case should be given the patient or parent, accompanied by a plain statement of the difficulties of the case, if such exist, the probable time that will be required for correction, and an approximate estimate of the cost. To avoid any possible misapprehension, the patient should also be informed that

the appliances will cause some annoyance and possibly some pain, and that patience, endurance and perseverance will be necessary on his or her part to enable us to accomplish a satisfactory result.

It should also be mutually understood that the parent or patient shall assist in the furtherance of the work by seeing that the appliances are faithfully worn, that all the instructions are carried out, and that the patient shall punctually meet all appointments that may be made.

Should the prognosis of the case prove satisfactory and all of the above conditions be agreed to, we may at once proceed with the treatment.

IMPRESSION AND ARTICULATION.

The first step will be to take impressions of the upper and lower teeth, from which to secure models for the further and more exact study of the case.

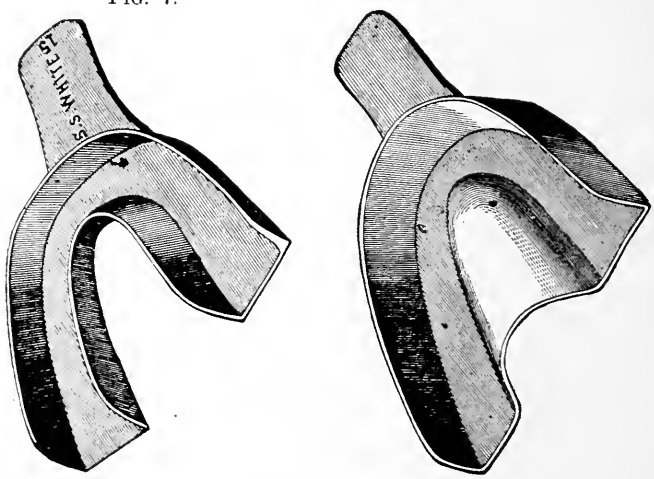
These impressions should be taken with some material that will receive a sharp imprint, and not materially change its shape in removal from the mouth. Either Plaster of Paris or Modelling Composition (Stent's or Godiva) will give satisfactory results, but as the former can only be removed from the mouth by being broken into many pieces the latter is generally preferred. In selecting the impression cups, those known as flat-bottom cups (Figs. 7 and 8) should be chosen, on account of the better accommodation they afford for the crowns of the teeth. The cups should in all cases be large enough to allow for a sufficient quantity of the material along the outer rim to enable a perfect impression to be taken of the labial and buccal surfaces of the teeth, and as much of the gum above them as possible.

A proper quantity of the composition having been softened by dry heat or in hot water, it is placed and properly shaped in the previously warmed cup and rapidly introduced into the mouth.

In taking an impression of the upper jaw the mouth

should be kept well open so that the teeth may not come in contact with the material before the proper time and thus mar the surface. When the cup with its contents has been placed

Fig. 7. Fig. 8.



Impression Cups.

as far back as necessary, and immediately beneath the teeth, it should be brought up into position with a straight and steady movement. Once there, it should be firmly held while a finger is introduced to force forward into position that portion of the material which has escaped at the rear of the cup, after which all that portion along the outer rim should be pressed against the teeth and gums from molar to molar.

In this position it must be firmly held until it has become so hard that a finger nail will scarcely indent it, when it should be carefully removed. The hardening is best hastened by a stream of cold water from a syringe, or by the renewed application to the cup of small sponges dipped in cold water as suggested by Prof. Newkirk.

In taking an impression of the lower jaw, the same general method is followed, and after the cup is well in place all the surplus material around both the outer and inner rims should be pressed into place with the finger.

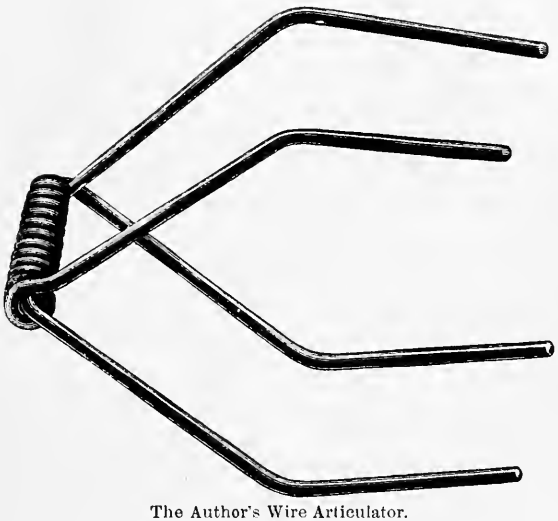
The models obtained from impressions taken in this manner will be sufficiently accurate to give us a good representation of both the buccal and lingual surfaces of the teeth, so necessary to a proper study of the case.

Impressions taken in plaster are the most accurate in detail, but the composition gives us all the accuracy we need in models for regulating.

During the same sitting at which the impressions are taken, the manner in which the teeth occlude should be observed and recorded, so as to enable us to place the models in proper relation while being attached to the articulator. This will dispense with the necessity for taking a bite.

An inexpensive and excellent articulator, Fig. 9, for the mounting of models of irregularity, is made from brass wire. The upper arms and coil are one continuous piece, while the lower arms are formed by passing another piece of the wire through the coil and bending to shape.

Fig. 9.



The Author's Wire Articulator.

The articulator is so slender in outline that after the models are attached to it the occlusion of the inner cusps of the teeth may be as readily examined as that of the outer ones.

With the models properly mounted on the articulator, our second and more deliberate study of the case may be carried forward at our leisure.

At the first or personal examination of the case, we are supposed to have decided upon the advisability of an attempt at correction, and also upon the general plan we purpose pursuing. By the study of the articulated models, we will be enabled to decide upon the details of the work, and the kind of appliance that should be used. Both studies are necessary, for with the patient in the chair we cannot take the time to map out the proposed work in detail, while an examination of the models alone will leave us without a knowledge of many important characteristics of the case that can alone be gained from a personal examination.

STUDY OF CASE FROM ARTICULATED MODELS.

The study of the case may be either a simple or difficult one, according to the conditions and requirements involved. Thus, the movement of a single tooth will only involve the consideration of providing accommodation for it in the arch and the manner of applying force to bring it into position, whereas when a number of teeth in different locations are to be moved, each perhaps requiring a different form of movement, we will have to decide whether we can and should produce all of these movements with one appliance at one time, or whether it would be best to produce each movement separately and possibly with different appliances. If the latter, we will have to determine which should be accomplished first, which next, and so on.

For instance, where the entire upper arch is to be expanded to make room for outstanding cuspids, we will have three different operations to perform; the side teeth must be moved laterally, the anterior ones forward and the cuspids inward into line. To produce all of these movements at the same time with one appliance, would be impossible from the nature of the case; therefore they will have to be performed separately, and usually in the order in which they have been named. In attempting to produce many movements with one appliance, we often defeat our object; although occasion-

ally, where the movements to be produced are of opposite character, we may advantageously play one against the other.

Where they are of the same character, or nearly so, too much should not be attempted at one time, for the loosening of many teeth will be liable to make our anchorage unstable, in which case we would have to suspend all operations until some of the teeth again became firm.

Having decided upon the order in which the movements should take place, we have two other important points to determine.

Amount of power required.—This will be determined largely by the age of the patient and the character of the teeth and process. As previously stated, at an early age, before the process has become fully calcified, the teeth can be moved more rapidly than at a later period, and less power will be required to accomplish it; so also, in patients of the same age, the teeth of one will be more readily moved than those of the other. This is due both to the relative length of the roots and the resistance of the alveolar walls, and as we cannot judge of the lengths of the roots from the appearance of the crowns alone, we have to form our opinion in the matter from the general conditions.

Observation has shown that teeth with large crowns, situated in large and firm looking jaws, usually have long roots; whereas, smaller teeth, associated with thin and more delicate processes, have shorter roots.

Therefore, considering the age of the patient and the appearance of the teeth and processes, we can at least decide whether the amount of force to be applied should be great or little.

Manner of applying power.—Among the many appliances or substances for yielding power in the moving of teeth, the practitioner has a range of choice from the screw with its directness and power, to the silk ligature with its gentle traction.

Between these two extremes we have materials that will

yield us force of any desired degree. Selecting the one which seems best suited to the case, we must next decide upon the most advantageous manner of using or applying it.

There are two general methods of securing the power-producing appliances in the mouth. One is the use of a plate of some kind to which attachments can be made, and the other is the plan of attaching the appliances to the natural teeth in such a way as to dispense with the wearing of a plate.

In certain methods of regulating, such as Angle's and Patrick's, no plate is used; while in others, such as Coffin's, a plate is invariably used for attachment and security. Farrar advocates the use of a plate only in exceptional cases. Each manner has its advantages and disadvantages. In the use of a plate, we have as advantages:—

Its convenience and adaptability.—Covering a large surface, it affords opportunity for the attachment of the immediate power-yielding appliance in any position and at any angle, and permits the same to be altered or changed with very little trouble. It also protects the soft tissues from any possible injury which might result from the slipping or impingement of other appliances upon them. Indeed, in many cases, a plain rubber plate covering the roof of the mouth and not having any appliances attached to it, is used simply for the protection of the gums during the operation of regulating.

Its distribution of the power of resistance.—Touching all or nearly all of the teeth not being operated upon, it compels each one to bear its part in offering resistance to the power used for the movement of certain teeth, and in this way brings more teeth into use as points of resistance than can possibly be done by any other method.

Its simplicity of construction and the facility it affords for adjustment and alteration.

The disadvantages pertaining to the employment of a plate as an aid in regulating, are:—

Its uncleanliness.—Inasmuch as a plate comes in contact with so much tooth surface at the necks and elsewhere, it

offers special opportunity for the accumulation of debris. In plates that are removable by the patient, this may be largely avoided by frequent cleansing, but observation has shown that the majority of patients are either so careless or indifferent in regard to the matter, that a clean regulating plate is seldom seen. In plates so constructed or arranged that only the dentist can remove them, the uncleanliness of the plate is greatly increased.

The frequent appointments necessary.—In the class of plates last alluded to, it is absolutely important that they be removed and cleansed at least once in every forty-eight hours. This requires such frequent visits on the part of the patient and the expenditure of so much valuable time on the part of the operator, as to constitute a great objection to the use of such plates where they can at all be dispensed with.

Notwithstanding these disadvantages, however, the employment of plates is necessary in many cases.

When plates are not used, appliances are usually attached directly to certain teeth which serve as anchorages. Such attachment is generally secured by means of bands or collars encircling the teeth and cemented to them; or, in other cases, by having the bands simply passed around the teeth of attachment and drawn tight by means of screws or clamps.

The advantages of appliances attached to the teeth in this way are:—

1st. The leaving of the roof of the mouth uncovered, thus affording more room for the movements of the tongue.

2nd. Their greater cleanliness, because they touch the teeth at few points, and thus furnish good opportunity for thorough cleansing with the brush.

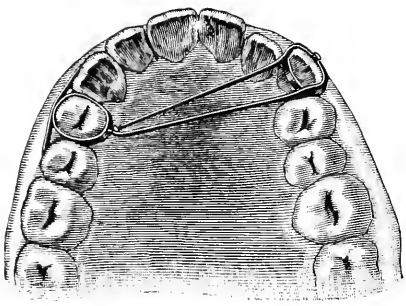
3rd. Not needing to be removed often, fewer visits to the dentist are necessary, thus effecting a great saving in time and labor.

The disadvantages of this manner of attachment are:—

1st. The fewer teeth that are brought into service in anchoring the appliance. In any simple case of regulating

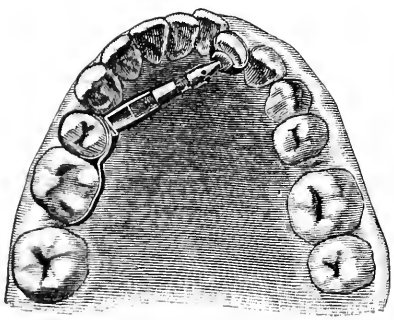
this objection would have but little weight, for the amount of resistance needed could readily be obtained; but in complicated cases there would be great likelihood of the anchorages proving insufficient to resist the great force brought to bear upon them. This objection may be largely overcome by making such extensions or additions to a band as to cause teeth adjoining the banded ones to bear their part in offering resistance. Extensions of this character, as used in the author's practice, may be seen in cuts 10 and 11.

Fig. 10.



In Fig. 10, a bicuspid is banded, and to the band on the buccal side is soldered a strip of platinized gold long enough to reach to and rest upon the adjoining teeth, causing them to bear their part in affording the needed resistance. We thus get the resistance of three teeth with the use of a single band.

Fig. 11.



Increased Anchorage.

In Fig. 11, an extension strip of gold is soldered to a bicuspid band, in order to obtain the additional resistance of the adjoining molar.

Dr. Angle recommends the banding of two adjoining teeth and having these bands united before being placed in position. He claims that by this method the resistance is greatly increased, for the anchor teeth to move at all would have to move bodily forward in an upright position instead of tipping. So much resistance to this

form of movement would be offered by the mass of alveolar tissue involved, as to make it almost impossible of accomplishment.

2nd. The injurious effect of bands upon the teeth. When bands are placed around teeth and secured by some mechanical device, they never can fit the teeth so accurately as to avoid spaces for the accumulation of food and saliva. The fermentation of the particles of food, and the acidity of the saliva in a state of rest, will soon injuriously affect even good tooth structure.

This can only be prevented by the employment of some material that will perfectly fill the space between the band and the tooth. Experience has abundantly proven that all bands passing around and encircling the teeth, in order to be harmless, should be cemented in place either with oxychloride or phosphate of zinc.

CHAPTER II.

APPLIANCES.

MATERIALS AND THEIR USES.

During the study of the case, after we have decided upon the amount and kind of power we wish to apply in order to produce the desired movements, we will have to consider the different materials at our disposal in order that we may select from them the ones best suited to our purpose for the case in hand.

PLATINUM AND ITS ALLOYS.

Platinum on account of its tastelessness, its non-oxidability and its harmonious color, should constitute it one of the best metals for use in the mouth. Its extreme pliability and softness, however, greatly limit its usefulness, so that it can be used only where these latter qualities do not interfere with its employment.

It is chiefly used in the construction of bands that are to be cemented to the teeth to serve as anchorage for appliances or to form parts of retaining fixtures.

In combination with other metals, in the form of alloys, its greatest usefulness is developed.

IRIDIO-PLATINUM.

This alloy, combining the color and purity of platinum with the hardness and stiffness of iridium, is useful for bands, bars and wires, in connection with regulating appliances where platinum alone would not be available on account of its softness.

PLATINIZED GOLD.

Gold in a pure state, or alloyed with silver or copper, does not possess the stiffness necessary for its use in the form of

bars, springs or accessories, where great resistance or elasticity is requisite, but when alloyed with about five per cent. of platinum it attains a degree of elasticity second only to steel. In this form it is one of our most useful materials, for even the heat of soldering does not rob it of its elastic quality.

This alloy of gold can be purchased in the dental depots in plate of any thickness and in wire of any form or size. When used for the construction of screws or supports, its stiffness is the quality taken advantage of, while in the form of levers or bows its elasticity constitutes its chief excellence.

PLATINIZED SILVER.

This alloy, though long and favorably known in England, has never been extensively used in America. It is prepared for the market in the form of plate and wire of every gauge. In the form of plate it is largely used abroad as a base for artificial dentures, especially small partial pieces, while the wire is used as a support for the Ash tube-teeth and other purposes.

The alloy is composed of one part of platinum to two of silver. Its stiffness and elasticity is but little inferior to platinized gold, while its cost is less than one-third that of gold. It can be rolled, bent or fashioned in any form and may be soldered with the highest grades of gold solder.

In the form of wire the author has found it very useful in the construction of bows for the attachment of rubber bands or ligatures to draw teeth in any direction, and for parts of retaining appliances where inconspicuousness is desirable.

Its non-oxidability is also a feature of considerable value.

GERMAN SILVER.

This improperly named alloy, composed of copper, zinc and nickel, is frequently employed by some practitioners in the construction of regulating appliances, on account of its

stiffness and inexpensiveness. While it may be regarded as a base compound, its baseness is of so high a grade that it may be used without fear of harm to the soft tissues or the general system. Prof. Angle uses it almost exclusively in the construction of his appliances, and the author has made frequent use of it without ever noticing any detrimental effects. Its valuable qualities are too many for us to deprive ourselves of.

GOLD.

Gold, in its non-elastic condition, has been and probably always will be one of the most useful of the metals for the construction of parts of regulating appliances. Its softness, adaptability and strength are all qualities of the greatest value and render it serviceable in numberless ways. To preserve its purity, and as far as possible to prevent oxidation, it should never be used of a carat less than 20 or 22.

STEEL.

This metal has the same desirable qualities of firmness and elasticity that are found in platinized gold, and possesses them in a higher degree, so that it is used in preference to the former metal where greater power is needed.

There are two disadvantages, however, connected with its use:—one is, that it cannot be highly heated (as in soldering) without losing its temper; and the other, that it oxidizes so readily when in contact with the fluids of the mouth. But for these drawbacks it would be employed more frequently in connection with regulating appliances. It is used principally in the construction of jack-, and other screws, and as wire in the form of bows, levers and springs.

In the latter form its use was first brought prominently before the profession by Mr. Coffin, of England, in connection with his method of regulation.

VULCANITE.

Soon after the introduction of vulcanite as a base for artificial teeth, its qualities of adaptability, strength and elas-

ticity were recognized and utilized in the construction of appliances for regulating. By its use we secure advantages that could neither be so readily nor so well gained by any other known substance.

Used either to produce pressure by its own elasticity, or as a medium for the attachment of other power-producing appliances, its value cannot well be over-estimated. It has been and is now one of the most commonly employed materials for the construction of regulating appliances. Some of the many ways in which it so admirably serves us are shown in Part III.

COMPRESSED WOOD.

The use of this substance is very old. Before the introduction of either soft or vulcanized rubber, the quality of the expansion of compressed wood under moisture was employed in lieu of elasticity.

It was chiefly used in the form of small sections placed between a silver or gold plate and the teeth to be moved, a suitable slot or socket for its retention having been formed in the plate.

In this way it is no longer used, other materials possessing superior qualities having superceded it.

The author occasionally finds great advantage from the use of compressed wood in the separation of teeth for the accommodation of some malposed tooth, where the existing space, though not sufficient, is still too great to admit of the use of elastic rubber.

In such case it is his custom to cut a cross-section from some compressible wood, such as cotton-wood, a little larger than the space it is to occupy. This is compressed in the direction of the length of the fibre by means of a hammer, after which it is notched at each end to fit the convex surfaces of the teeth to be moved. Upon being placed in position its expansion by the absorption of the fluids of the mouth will quickly cause the movement of the teeth. In the course of its expansion it adapts itself accurately to the

tooth surfaces and thus does not become dislodged or slip from its position.

SEA-TANGLE.

This is one of the newer substances introduced into the list of materials that are of service in regulating. The idea of its use was borrowed from the medical fraternity, who first employed it for distention of the cervex uteri. It is a variety of sea-weed robbed of its moisture and compressed until its density is about equal to that of horn. For medical use it comes in the form of a cylindrical tent about one-fourth of an inch in thickness and two inches in length.

This is the only form in which it has been placed upon the market. In the presence of moisture it rapidly expands from two to three diameters. As it expands only in the direction of its width, sections from it must be so cut and shaped as to take advantage of this lateral enlargement.

In regulating it may be employed in place of compressed wood, and like it is used to produce pressure between the unyielding plate and the tooth to be moved. A place for it is readily provided by cutting a hole or socket in the rubber plate at the desired point.

Its advantage over rubber or wood lies in its greater expansive properties and the ease with which it can be secured in place. A piece of suitable size can be placed in position, and the plate properly secured in the mouth before expansion begins.

ELASTIC RUBBER.

The resilience of elastic rubber was early recognized as a valuable property that might be used to advantage in producing traction upon teeth to be moved. It was first used in the form of strips attached at either end by ligature, but since the introduction of rubber tubing, rings or bands cut from the same have been employed instead. Their first employment has been credited to Dr. E. G. Tucker, of Boston, about the year 1846.

These sections, cut from the smaller sizes of French rubber tubing, are now in almost universal use in connection with other appliances for regulating, and their value has been greatly enhanced since the Magill band has furnished a better means for their attachment.

Their power, though great, is limited, for they cannot exert so great a force as the metals; but their wide range of applicability and the persistence of their power places them among the most valuable adjuncts of regulating devices.

In use, their tendency to slip off the tooth or up under the gum (which constitutes the chief objection to their employment) must be guarded against by so securing them that change of position will be impossible. They should never be permitted to rest upon or touch the soft tissues at any point.

SILK LIGATURES.

The contraction of silk, linen or cotton thread in contact with moisture, enables us to make use of it where the gentlest tractile power is desired. Most frequently it is employed simply as a ligature in attaching some appliance to the teeth; but it has often been used to advantage in cases where teeth were to be moved slowly and a very short distance. Prof. Peirce employs it in this way for the moving of certain single-rooted teeth, as described in Part III. Its gentle power, together with its safety and simplicity, will often prove the very qualities we desire in certain simple operations.

QUALITIES AN APPLIANCE SHOULD POSSESS.

In selecting a form of appliance from among the many that have been devised by writers and workers in this field of practice, or in devising one to suit the demands of the case under consideration, it will be well to consider and bear in mind the qualities any appliance should possess in order to render it most effective.

The following are among the most important of such qualities:—

Efficiency.—The first requirement of any device is, that it shall be able to do the work expected of it. All appliances are, of course, devised with this end in view, but the attainment of it is often not as simple a matter as might at first appear. Almost every case has associated with it so many features and peculiarities claiming consideration, that even with the greatest care and thought we often fail to apprehend or grasp each individual complication. Some, indeed, are so little apparent that they can scarcely be recognized in advance.

For this reason even the most experienced practitioners will at times devise an appliance which, though seemingly meeting all the requirements, will, when brought to a practical test, fail to accomplish the end desired. It will then have to be altered, or perhaps discarded, in favor of some other fixture more perfectly adapted to the requirements of the case.

An appliance that will not yield the results we desire, or which yields them in an imperfect manner, should in all cases be superseded by another.

Simplicity.—A complicated device is in nearly all cases less efficient than a simple one. Simplicity is a cardinal virtue

in all matters of construction, and through lack of it about seventy-five per cent. of the patents granted in this country prove unprofitable.

Far greater mechanical ingenuity is displayed in an effective simple device than in a complicated one.

Rapidity of action.—In order to lessen the discomfort of the patient, and to conserve the time of both patient and operator, a regulating appliance should be as rapid in its action as is consistent with physiological conditions. Too rapid action may cause suffering to the patient, and possibly bring about deleterious results; while too slow action will prolong the treatment unnecessarily, and possibly cause the patient to become disheartened and abandon the treatment.

Between these two extremes there is a mean in which the best results are accomplished.

All regulating appliances are at best a source of some discomfort to the patient. A foreign body in the mouth, occupying a certain amount of space and thereby interfering more or less with natural functions, cannot fail to be objectionable. In order, therefore, to lessen this discomfort as much as possible, we should try to devise appliances that will occupy no more space than is necessary, and also have them free from all rough projections. Very little is required to cause abrasion of or injury to the soft tissues of the oral cavity, and when once caused such lesions are the source of much pain.

Least interference with speech and mastication.—Most patients apply to us for correction of irregularity at a time when their education is in progress. Their lessons must be recited, and their enunciation must be distinct enough to be understood by the teacher. With a large and cumbersome appliance in the mouth it would prove very difficult for them to speak distinctly, and they would thus be placed at a disadvantage.

They are also in their growing age when the body needs an abundance of nutritious food to supply the demands of the various tissues. If mastication be insufficient through imperfect occlusion or through tenderness of the teeth caused

by a bulky fixture, nutrition will be inadequate to the needs of the system.

Such conditions can and ought to be avoided by a properly constructed appliance.

Cleanliness.—The cleanliness of any appliance will depend both upon the method of its construction and the care that is taken of it. If it be removable so that the patient can take it out, cleanse and reinsert it, there ought to be no difficulty about its being kept clean. The patient should be instructed to remove it for cleansing at night, in the morning, and after each meal, at the same time giving the natural teeth a thorough brushing.

A good plan is to supply the patient with a brush, properly marked, to be kept in the office. When the patient appears and the appliance is removed, the operator should see that both plate and teeth are well cleansed in his presence. This one cleansing he will be sure of, though he may not be certain of the others. The same plan is pursued with plates or appliances that can only be removed by the operator. Where appliances are of such character that they seldom need to be disturbed, the patient should be taught to take a quantity of water in the mouth, and then using the lips and cheeks bellows-fashion, force the water through every interstice of the teeth and appliance to flush out accumulations. This should be done each time after eating, as well as before retiring and after rising.

Most appliances can be worn a long time without injury to tooth substance, if they are properly constructed and kept scrupulously clean.

Without cleanliness, the teeth will soon be injured by the secretions and accumulations, and the breath of the patient, from the same cause, will become so offensive as to disgust all brought within its range.

Inconspicuousness.—Annoyance from wearing a conspicuous appliance is often added to the other ills which the patient is subjected to during the process of regulation. An

appliance of this character, while often producing distortion of the lips, also attracts much attention and compels the wearer to make frequent answer to the same oft-repeated question.

Young persons attending school, or entering society, are naturally very sensitive to the ill-appearance of any conspicuous device. Whenever the same result can be accomplished by a concealed fixture as by an exposed one, it is better to adopt the former; but where a better or more satisfactory result can be obtained by the use of a more prominent fixture, appearance will, of course, have to be subordinated to utility.

Stability.—The quality of stability has previously been spoken of, but its real practical importance cannot be too strongly insisted upon. It is a *sine qua non* in orthodontic practice. With it, we have a reasonable certainty of results; without it, all is uncertainty.

In some cases, as where most or all of the superior teeth are to be drawn backward, we have apparently no point for proper anchorage. Stability or fixedness of position for an appliance, in such cases, not being obtainable within the mouth, some fixture can be devised which will have its point of resistance outside, as on the back of the head.

This plan of securing resistance outside of the mouth, has been adopted thus far only in a few exceptional cases, but it is hoped that its advantages and importance will lead to its more frequent employment in the future.

Freedom from injury to tooth substance.—By this we do not mean chemical injury, for that has already been treated of, but we refer to mechanical injury. Any sharp, hard point or roughness of a metallic appliance, will be likely to scratch and mar the surface of enamel and thus prepare the way for future decay.

Steel jack-screws of any form, when placed directly against the teeth of anchorage and those to be moved, are liable to work injury to tooth structure. For this reason there should

always be interposed between the teeth and screw some material that is non-injurious to the tooth. Besides protecting the teeth, such substance will also serve to give greater security to the screw.

To obtain this same fixedness for the point of a fish-tail jack-screw, or other appliance, some operators have been in the habit of drilling a hole or depression in the tooth to be moved. It is hoped that the introduction of the Magill band has caused the abandonment of this practice, which at best was only justifiable in exceptional cases and in self-cleansing localities.

RETAINING APPLIANCES.

The retention *in situ* of teeth that have been moved, for a time sufficiently long to allow them to become firm, is quite as important as the moving of them. As previously explained, teeth become firm in their new position by virtue of a deposit of ossific matter in the space created by their displacement. The formation and perfect ossification of this new material, is only completed after a lapse of time varying with the age and constitution of the individual. Experience has proven that a less time than six months should never be allowed for it, while in persons of mature age or in those younger where many teeth have been involved, the time will sometimes have to be extended to a year or longer.

The natural tendency of a tooth to return to its former position, aided by the tension of the parts that have resisted its movement, will certainly move a tooth from its new position, unless the newly formed process has become thoroughly calcified, and is thus by its strength and density able to resist the opposing forces. Numberless failures to retain the good results of regulation are attributable to this cause alone.

In certain cases, as where a superior incisor has been occluding inside of the lower ones, or where a lower one has been biting outside of the upper ones, no retaining appliance will be required after they have been brought into proper position, because the natural occlusion of the jaws will prevent the corrected tooth from returning to its former position.

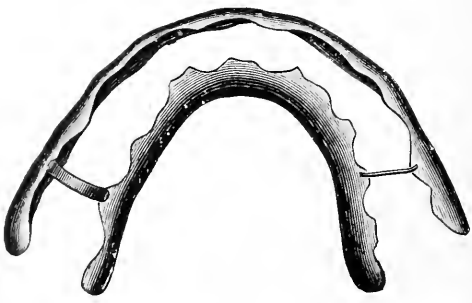
So also with the bicuspids and molars. Where malocclusion has forced them out of their true position, or kept them there, the correction of the occlusion will often tend to retain them in their normal positions without extraneous aid.

In all other cases, however, mechanical assistance will be necessary until the teeth have become firm. Where the arch

or any portion of it has been enlarged, or where a number of teeth have been moved from within outward, the simplest and probably the best means of retaining them will be the wearing of a thin rubber plate covering the palatal arch and nicely fitting each tooth at its neck. It may contain a vacuum-chamber or not, as preferred, but in many cases the use of one will greatly assist in keeping the plate in place. In addition to its use in preventing teeth from moving inward, the plate may often be advantageously modified by the addition of a gold hook or spur to keep rotated teeth in position, or to retain individual teeth that have been moved inward.

In cases where it is necessary to retain a number of teeth that had formerly occupied positions outside of the arch, or where some had stood outside and some inside, probably no plan yet devised equals in simplicity and efficiency the one suggested many years ago by Dr. Richardson. The accompanying illustration (Fig. 12) represents its general appearance. It consists of two narrow strips of vulcanized rubber about one-fourth of an inch in width, the one fitting the gum and necks of teeth on the palatine surface, and the other the same portions of the buccal or labial surface. The two are either continuous around the last molars, or they are separate there and joined at two other points by pieces of flattened gold wire vulcanized into them. These wires can be placed at points where a tooth is missing or where space exists between the teeth; or, if the articulation of the teeth be not too close, they can be passed over the depressions between crowns on

FIG. 12.



Richardson's Retainer.

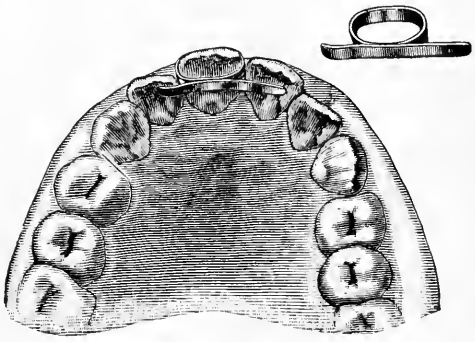
the masticating surface. The appliance is light, occupies little space in the mouth, and is not very noticeable.

While rubber plates in some form, either by themselves or in combination with accessories, are the most commonly approved appliances for retaining corrected teeth, their use is, nevertheless, open to certain objections. All rubber plates used either for correction or retention, must be removed at frequent intervals for cleansing. The very necessity for their removal affords opportunity for the patient to remove them at other times, and possibly forget or willfully neglect to reinsert them for a longer or shorter period, thus causing delay in the reparative process.

Besides this, also, in the very act of removal and insertion the teeth are slightly moved in their sockets, and this will to a certain degree hinder the re-formation of tissue.

On account of these objectionable features the author has for many years avoided the use of rubber retaining plates, wherever he could do without them. As a substitute he was led to devise a number of little appliances of gold and platinum, occupying the least possible space, and firmly attached to the teeth for the required time. Fig. 13 shows one of these appliances in its simplest form. It consists of a platinum (Magill) band, freely fitted to the tooth, and having a gold bar or spur soldered to it to press or bear against one or more of the adjoining teeth. When properly adjusted, it is secured to the corrected tooth by means of phosphate of zinc.

FIG. 13.



The Author's Band and Bar Retainer.

As will readily be seen, its advantages consist in its small

size, its slight contact with teeth other than the one upon which it is placed, its cleanliness, its fixedness, and the firmness with which it holds the corrected tooth in place.

The latter is its most important feature, for it is a well recognized fact in surgical practice that, other things being equal, reunion of bony tissue or new formation of the same will progress in rapidity proportionate to the stability of the parts.

FIG. 14.

Retainer.

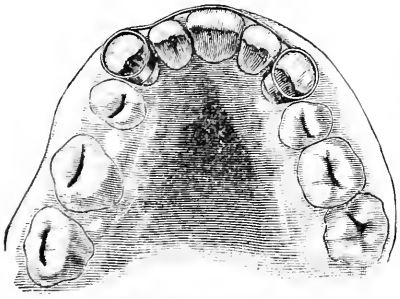
Fig. 14 shows a modification where two teeth are thus to be retained, with the extension bar long enough to include more distant teeth. Fig. 15 represents two bands joined at their borders, for the retention of two teeth that have been rotated.

FIG. 15.

Retainer.

Still another modification is shown in Fig. 16. In this case the two bands on the cuspids are united by a thin gold or platinum wire passing along and conforming in the outline to the labial surfaces of the intervening teeth. It was used to retain three incisor teeth that had been drawn inward.

FIG. 16.



Band and Wire Retainer.

Retaining appliances of this character cannot, of course, be used to advantage in all cases; but where they can they will be found to be most satisfactory.

FIG. 17.

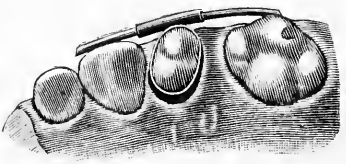
Angle's Retainer.

Prof. Angle uses a retaining appliance differing from the foregoing in having a tube soldered horizontally to the band that encircles the tooth. The tooth once in position a wire is passed through the tube and made to rest upon the adjoining teeth, after which a hole is drilled through both tube

and wire and a short pin inserted to prevent the wire from shifting its position. See Fig. 17. Dr. Talbot uses an appliance closely resembling that of Prof. Angle. See Fig. 18.

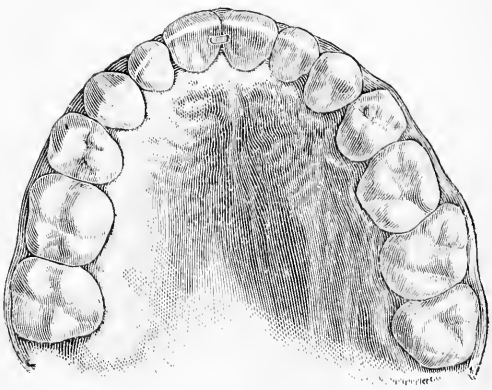
Another simple and ingenious device for retaining teeth after they have been moved, especially after rotation, was shown the author by Dr. H. L. Baker. It consists of a gold screw cemented into some conveniently located cavity in such a way that the protruding portion shall rest against an adjoining tooth, and thus prevent the tooth operated upon from changing its new position. Such device could, of course, only be used in rare and exceptional cases; but where applicable, it possesses the advantages of simplicity, inconspicuousness and efficiency. Fig. 19 represents a case in which a rotated incisor was thus retained.

FIG. 18.



Talbot's Retainer.

FIG. 19.



Baker's Ratainer.

CHAPTER III.

CONSIDERATION OF METHODS.

FARRAR'S METHOD.

In 1876 Dr. J. N. Farrar began publishing a series of articles in the *Dental Cosmos*, descriptive of a method he had devised for the regulation of teeth. Reading and observation, he said, had satisfied him that the various plans suggested up to that time for the correction of irregularity, were lacking both in system and principle. He claimed that the performance of so important an operation as regulation should be based upon a correct knowledge of both mechanical and physiological law.

Experience had convinced him that the character of force applied to the teeth should be *positive*, and that it should be *intermittent*—a period of rest following a period of motion.

The best instrument for applying a force that is positive and may be intermittent, he said, was the screw in one of its various forms.

Experimenting with appliances constructed upon the screw principle, convinced him that this method of delivering force was not only positive and direct, but also that its range of applicability was so great that it might be used to the best advantage in nearly all cases of regulating. He claimed, also, that it was the only instrument whose force could be controlled at will, and thus be made to exert power upon or retain in a state of repose the tooth or teeth operated upon.

This alternation of motion and rest in changing the position of teeth, was as important as in other organs of the body, and was in strict accord with physiological law. In his experiments he found that intermittent force was pro-

ductive of less pain to the patient than continuous force, and might be so skilfully applied as to prevent all pain.

Pain, he said, was an expression of a pathological condition, and by its avoidance we kept within the boundary separating the physiological from the pathological state. With screws of known pitch and number of threads, he found that he could move a tooth painlessly, and therefore safely, from $\frac{2}{240}$ to $\frac{1}{160}$ of an inch every twenty-four hours. His experiments led him to the following conclusions:—*

"*1st.* That in regulating teeth, the traction must be intermittent, and must not exceed certain fixed limits.

"*2nd.* That while the system of moving teeth by elastic rubber apparatus is unscientific, leads to pain and inflammation, and is dangerous to the future usefulness of the teeth operated upon, a properly constructed metallic apparatus, operated by screws and nuts, produces happy results, without pain or nervous exhaustion.

"*3rd.* That if teeth are moved through the gums and alveolar process about $\frac{1}{240}$ of an inch every morning, and the same in the evening, no pain or nervous exhaustion follows.

"*4th.* That while these tissues will allow an advancement of a tooth at this rate ($\frac{1}{240}$ of an inch), twice in twenty-four hours, the changes being physiological, yet, if a much greater pressure be made, the tissue changes will become pathological."

The above conclusions were epitomized by him into the following Law:—"In regulating teeth, the dividing line between the production of physiological and pathological changes in the tissues of the jaw is found to lie within a movement of the teeth acted upon, allowing a variation which will cover all cases, not exceeding $\frac{1}{240}$ or $\frac{1}{160}$ of an inch every twelve hours."

A full elaboration of his theories, together with a descrip-

* *Dental Cosmos*, Vol. XVIII, p. 23.

tion of methods, illustrated by engravings of numerous appliances devised by him, may be found in the *Dental Cosmos*, extending from Vol. XVIII to XXIV.

Although the screw principle was the one which he principally used, and the only one which he considered scientifically and physiologically correct, he at times availed himself of the use of some of the continuous-force appliances, such as rubber bands,* silk or fibre ligatures,† and for the attachment of appliances, vulcanite plates.‡

So far as the principles upon which Dr. Farrar's system is based are concerned, they have received but limited public approval on the part of the profession; but the multiplicity and variety of his appliances and the ingenuity displayed in their devising, have commanded the admiration of all and been of great value to laborers in this field. Most of his appliances are original in design, beautiful in construction, and well calculated to perform the work intended; but in confining himself so largely to the use of one form of power-producing instrument, his apparatus is in many cases very elaborate and complicated. The same end could often be accomplished by much simpler means.

Dr. Farrar's appliances are so numerous that illustrations of all of them could not be introduced into a text book, nor could they well be selected from to illustrate his principles, but some of them may be found in Part III, where the practical treatment of various forms of irregularity is considered.

PATRICK'S METHOD.

In 1882, Dr. Patrick brought forward his method of regulating. His appliance is made of gold, and designed to be attached directly to the teeth on presentation of patient, without the usual preliminaries of taking an impression and making a model.

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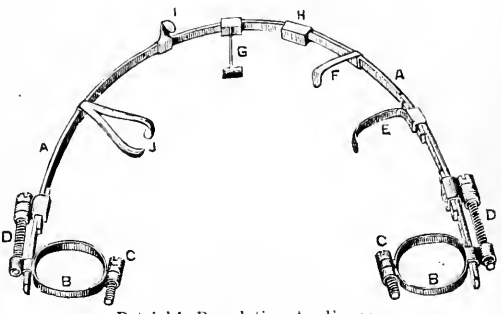
* *Cosmos*, Vol. XIX, p. 520.
† " " XXI, " 306.
‡ " " XXI, " 305.

The appliance with its appurtenances, all beautifully constructed and ready for use, may be purchased from the inventor or through the dental depots.

The essential parts consist of a bow-spring, adjustable anchor bands, and numerous devices for engaging with the teeth to be moved. Fig. 20 represents the appliance with many of the accessories in position. The bow-spring "A" consists of a half-round bar or wire of platinized gold, bent in horseshoe form to approximately conform to the shape of the arch. "B B" are the adjustable loop-bands, made of thin gold plate, the free ends of which, on their palatine surfaces, are connected with a screw and fixed nut (C), for bringing the band in close contact with the tooth to which it is applied. On the buccal surfaces of these bands are soldered sections of half-round tubing, accurately fitting the bow-spring which plays through them. Outside of this tubing is soldered a nut threaded to receive the long buccal screw (D) intended to tighten the bow spring after it is in position, or to take up the slack caused by the moving teeth. The head of this screw passes through and operates against a smooth nut soldered to a section of the tubing which is temporarily attached to the bow-spring at any point by means of an adjustable double wedge.

FIG. 20.



Patrick's Regulating Appliance.

Of the accessory appliances shown, "E" is a hook intended to rest against the mesial or distal (by reversing) surfaces of a tooth intended to be moved in an anterior or posterior direction. It is secured in the desired position by a wedge placed between the inner flat surface of the spring and the adjoining surface of the slide to which the hook is attached.

The tooth is moved anteriorly or posteriorly by loosening the buccal screw on one side and tightening it on the other toward which the tooth is intended to be moved. "F" is a hook to catch over the cutting edges of incisors, when it is desired to move them from within outward. When in position the tension of the bow-spring is increased from time to time, by unscrewing the buccal screws. "H" is a slide, or section of the half-round tubing, reinforced on its palatine surface by additional gold, and intended to be used as a stud to prevent one portion of the tooth from moving while the opposite one is being moved, as in rotating an incisor. It is also used to press against any tooth as a wedge in moving it inward.

"G" is a T-bar for producing double rotation of the incisors. "I" is a hook set vertically to engage with the cutting edge of an incisor, to prevent the bow-spring from slipping up toward the gum.

"J" is a bifurcated hook, to grasp a cuspid tooth intended to be moved outward.

Each of these appurtenances is soldered to a section of the half-round tubing, which allows it to be moved to any desired position on the bow-spring. When in position, they are retained by means of the wedge already referred to.

As will readily be seen, the power obtained by this appliance consists partly in the elasticity of the bow-spring and partly in the direct action of the tightening screws.

The ingenuity displayed in the devising of this method is certainly very great, and the delicacy and accuracy of construction of the various parts all that could be desired. The combination of the principles of the spring and screw bring into play two of the most important powers available in regulation, and their correlation in this method is very happily brought about.

Like all other methods, however, a few objections stand in the way of its being as perfect as we could desire:—

1. All uncemented bands placed around teeth and kept

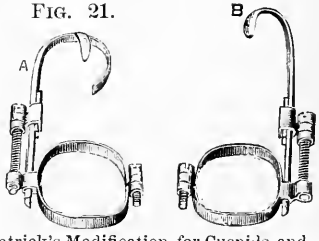
there for considerable time, are likely to work injury to the underlying tooth substance, unless the tooth-structure be of the densest variety. Cementing the bands to the teeth, according to the Magill method, will obviate this trouble and attach the bands to the teeth more firmly.

2. Dr. Patrick usually attaches a single band to a tooth on each side of the mouth to obtain resistance. When several teeth are firmly implanted in front of the banded teeth, they all add to the resisting power; but where there are none, or only one in front of them, the resisting power would seem to be too slight to move several teeth at once. Where two adjoining teeth are available for banding, it would be better to band both of them, and thus add to the stability of the anchorage.

3. The conspicuousness of the gold bar and its appendages, is another objection. Where exposure of gold or other materials cannot well be avoided, it becomes a minor consideration; but where it can be obviated, without impairing the efficiency of the appliance, it certainly should be. Dr. Patrick has also devised two additional appliances for moving individual teeth, where the irregularity is confined to one side of the arch, and where the bow-spring would be unnecessarily conspicuous and cumbersome. In these cases the power is obtained from the direct action of the screw alone.

Fig. 21 represents the device for moving a bicuspid either forward or backward in the arch; while Fig. 22 illustrates the same appliance modified for use in drawing a cuspid backward.

FIG. 21. FIG. 22.



Patrick's Modification for Cuspids and Bicuspids.

BYRNES' METHOD.

Dr. B. S. Byrnes has devised a method for regulating teeth by the use of narrow strips of fine gold variously shaped and bent to produce tension upon the malposed teeth. The

method is an exceedingly novel and ingenious one, and while it could not be used to advantage in all cases, still contains elements of merit that will be of value to the practitioner. His power is derived from the elasticity of the metal, which is corrugated in such a manner as to develop this quality in the highest degree.

His bands are made from gold plate of 20 to 22 k. fineness, rolled very thin, and when greater power is needed the bands are doubled in thickness. He uses no plates, but anchors his appliances by means of bands to suitable teeth, situated at some distance from the ones to be moved.

* The method of application, in a general way, is as follows:—The fixed points having been determined upon, the tooth or teeth to be regulated are connected with them by means of a thin gold band. The band is manipulated so as to form it into a spring, or series of springs, so adjusted as to bear most powerfully on the misplaced tooth. Thus, supposing that a projecting superior central incisor is to be drawn inward to align properly with the remainder of the teeth in the arch, a continuous gold band embracing the first molars on both sides is fitted around the outside of the arch.

With a dull pointed instrument, like a burnisher, the ribbon is then pressed into the interstices of the teeth over which it passes, thus forming it into a series of small springs. The incisor being the most prominent point will naturally be most affected by the pressure exerted by the springs, and in a short time it will be found to have moved away from the band, so that it is no longer affected by its tension. As soon as this occurs the apparatus is removed, the ribbon annealed and straightened, and a small portion, say a thirty-second to a sixteenth of an inch, as may be required, is cut out of it. The ends are then soldered and the appliance replaced upon the teeth, the connecting band being formed into a spring as before. Tension is thus kept

* *Dental Cosmos*, Vol. XXVIII, pp. 278-284.

up until the tooth has assumed the desired position. Sometimes the spring of the band may be advantageously supplemented by other aids, as the insertion of a rubber wedge (under the band) at points were a particular gain is desired.

Figs. 23, 24 and 25 illustrate the general appearance of the appliance in some of its forms.

Figs. 23 and 24 were used to draw in projecting incisors in the case of a young lady, aged 18. The movement was assisted by rubber wedges placed between the band and the labial surfaces of the teeth. "The connecting band was cut and shortened every other day, the patient having a sitting every day to allow the band to be sprung more as the teeth moved away from it."

FIG. 23.

FIG. 24.

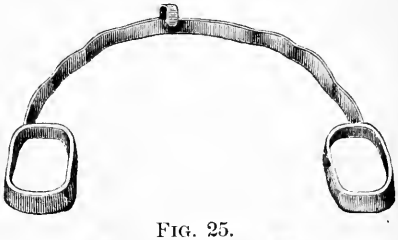
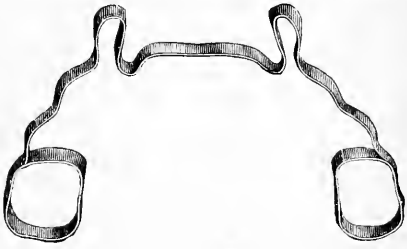


FIG. 25.



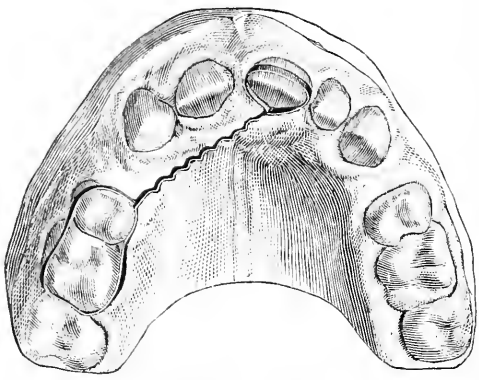
Byrnes' Band Regulators.

Fig. 25 represents the form of appliance used by Dr. Byrnes in drawing forward the lower incisors, and pressing back the cuspids at the same time. The band clasped the first molars of each side and passed around the cuspids and back of the incisors. By cutting and shortening the band from time to time as the teeth yielded to the pressure, the irregularity was easily and quickly corrected.

Fig. 26 shows the form of a corrugated band used to draw inward an outstanding central incisor in the upper jaw. Two teeth are here used as anchorages, being connected by a single continuous band.

Fig. 27 shows a more complicated apparatus than any of those previously described. It was used in a case where a right central overlapped the lateral. It illustrates how the method may be applied to turn a tooth where the force must be applied directly across the mouth.

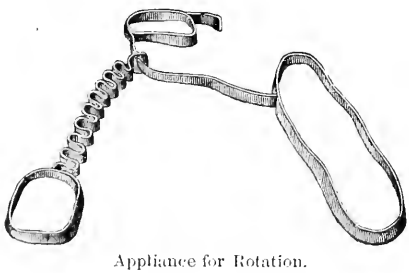
FIG. 26.



Byrnes' Corrugated Band.

After the necessary room was provided, this fixture was applied. It accomplished its work in four days, after which a retaining device was used, consisting of a simple band clasped tightly around the central which had been rotated, and provided with wings tipping on the left central and under the right lateral.

FIG. 27.



Appliance for Rotation.

THE MAGILL BAND.

This device, while not properly constituting a method, is considered here, because through its great value it has come to be an important factor in several methods of regulating devised since its introduction. Dr. W. E. Magill, having in common with other practitioners experienced the difficulty of attaching regulating appliances to the natural teeth in such a way that they would have a firm hold and not slip, devised the following plan of meeting and overcoming the difficulty:—

From a piece of platinum plate, No. 28. American gauge in thickness, he cut a strip about a line in width, and bend it to conform to the shape of the tooth, soldered it at the point where the ends overlapped, thus converting it into a band or collar. After attaching to this band any studs, pins or hooks that the case demanded, it was lined with oxy-chloride of zinc and slipped over the dried tooth to a point about midway between the cutting edge and neck.

Since the introduction of phosphate of zinc, it has been found to be a far better medium for the attachment of the band to the tooth than the oxy-chloride of zinc, formerly used. Once in position, the cement will harden in about five minutes, after which no ordinary force will be able to dislodge it. If a wire spring is intended to rest against and press upon a banded tooth, a hole or pit should be drilled in the band at a suitable point, before it is cemented in place. If rubber bands or ligatures are to be employed, suitable provision for their easy attachment may be made by previously soldering to the band a small gold hook, or a headed platinum pin taken from a vulcanite tooth. Where a jack-screw is to be used in the moving of a tooth, an abutment of platinum should be soldered to the band encircling the resisting tooth, and then be slotted to receive one end of the screw. The band of the tooth to be moved should also be re-enforced and drilled to accommodate the point of the screw.

When the operation is completed, or for any cause it may be desirable to remove the band, it is easily accomplished by protecting the enamel at the cutting edge of the tooth with a folded napkin or piece of chamois skin, and placing one beak of a pair of pliers upon it and the other upon the upper edge of the band, the closure of the hand will dislodge the appliance without in the least marring or altering its form. By this simple invention, one of the greatest difficulties hitherto experienced in regulating has been overcome, and its devising has almost introduced a new era in regu-

lating. For the purpose intended, there is nothing that approaches it in efficiency.

Before its introduction, attachment to the tooth to be moved was usually effected by means of a ligature ingeniously applied and made fast by some form of knot, or a pit or hole was drilled into the substance of the tooth to receive the point of a screw or other device and prevent it from slipping. The knots would often slip, and the drilling of pits was objectionable, so that the difficulties of securement were not overcome until the invention of this band.

By its use absolutely secure attachment and anchorage are obtained, and the moving of teeth is accomplished with far greater exactness than had previously been possible. When attachment was made by ligature, it was often necessary that the ligature should encircle the tooth at its neck, and when not necessary to place it there it would often slip into that position, owing to the shape of the tooth. The irritation of the soft tissues thus produced, was frequently the cause of much pain to the patient. The Magill band obviates this by preventing any fixtures attached to it from coming in contact with the delicate and sensitive mucous membrane of the gum.

Indeed, the author has found that by its use nearly all the pain of regulating has been done away with, for the pain attendant upon regulating by the old methods, was caused not so much by the slight irritation induced by the moving tooth, as by the impingement of ligatures, rubber bands and other appliances upon the soft tissues. The Magill band may therefore, we think, be credited with having done more to modify the pain accompanying regulation than any other device ever introduced.

In some methods of regulating, such as Farrar's and Patrick's, attachment is made to the teeth by means of an open band of gold, secured to the teeth by a nut and bolt operating upon the free ends of the band. Such device, while valuable, is more complicated, cumbersome and less cleanly

than the Magill band. It is also open to the objection previously noted, that of allowing the secretions to remain between the tooth and band.

Several of the author's methods of modifying the form of the band by means of attachments to increase its usefulness, will be illustrated in Part III.

ANGLE'S METHOD.

This method of regulating was first brought to the notice of the profession by its originator, Prof. Edward H. Angle, in a paper read before the dental section of the Ninth International Medical Congress, held at Washington, D. C., September, 1887.

The appliances used in this method are composed entirely of metal. Power is obtained by the well known mechanical forces of the screw and lever, the latter always being made of piano wire, in order to obtain the greatest amount of power.

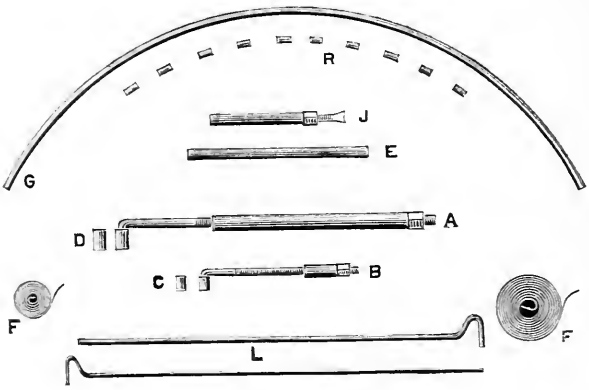
Support of the appliances or resistance, is gained by firmly attaching the parts to the teeth by the Magill band, which is always cemented in place.

The appliances are few in number, simple in design, and easily applied; qualities that add materially to the value of any device for general use. Prof. Angle, in describing his method, says:—

"Fig. 28 shows the simple appliances from which all the various combinations used in the method may be made. "A" is a large traction screw encased in its accompanying tube, and used for pulling where the resistance is great. "B" is a smaller traction screw, used in the same way where the resistance is slight, or where from any reason a delicate appliance is desired. "C" and "D" are tubes which are soldered to bands placed upon the teeth to be moved, into which the ends of the traction screws are hooked. "J" is a jack-screw, used for pushing, the end of which is beaten flat. "E" is an extra piece of tubing, by means of which a longer

jack-screw can be made. "F F" are coils of band material. "G" is a gold wire used in retaining, and "R R" are small

Fig. 28.



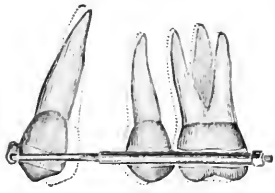
Angle's Appliances.

retaining tubes designed to be soldered to bands, into which the retaining wire accurately fits. "L L" are piano wire levers of varying sizes, giving different degrees of power.

"Aside from the advantages of simplicity, efficiency and cleanliness, which are insured by these appliances, a still greater desideratum is gained by means of the mechanical principles observed in their construction. Stationary anchorage and non-relinquishment of pressure are prominent features of this method, and are certainly secured almost to perfection.

"The means by which one or more teeth are held perfectly stationary, while serving as an anchorage or base of resistance for the application of force is quite simple, and peculiar to this method.

Fig. 29.

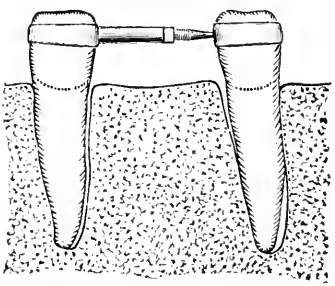


Stationary Anchorage.

"One or more teeth are banded, as shown in Fig. 29. Soldered to the bands is a tube of some length. Through this tube a rigid shaft, threaded at one end and bent to a right angle at the other, is

passed to a tooth to be moved. On turning the nut the natural tendency would be to tip the anchor teeth forward in their sockets; but they cannot tip thus, because of their rigid connection, and the length of tube surrounding the shaft. It is evident that two teeth thus connected cannot move, except as they move together. The apices of the roots must move the same distance as the crowns, if any movement at all occurs, and this is well nigh impossible. The tooth to be moved is connected with the shaft in such manner that it may tip, and responds by moving according to the force applied. The dotted lines of the diagram show the direction of any movement that occurs. Fig. 30 shows the same where the motion is pushing instead of pulling.

FIG. 30.



Lateral Movement.

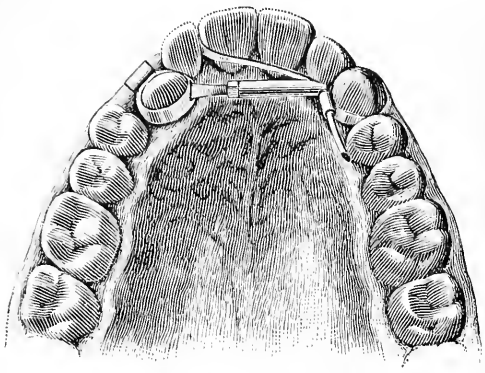
"The base of the jack-screw in this case is soldered to the band. Retention of the tooth is always anticipated, and in nearly every instance retaining tubes are soldered in position at the beginning of an operation, so that all that is necessary when the tooth is in place, is to insert the gold retaining wire and remove the power.

"A few of the principal movements are selected for illustration from the many modifications of which the appliances are capable.

"The application and operation of the direct screw is shown in Fig. 31. A firm anchorage for the resistance of the screw is obtained by banding and tubing the left cuspid, and passing through the tube a piece of gold wire long enough to extend to and rest against adjoining teeth. The opposite cuspid is banded, and a retaining tube soldered to the labial surface. The lingual surface has a slot cut

in it to receive the flat end of the jack-screw. The other end of the tube, in which the screw plays, is so filed that it rests securely against the re-enforcement wire and the tube upon the lingual surface of the cuspid band. After being brought into position, the tooth is held in place by passing a short piece of gold wire through the retaining tube on the labial surface, which is left in place until the tooth is firmly set in its new position.

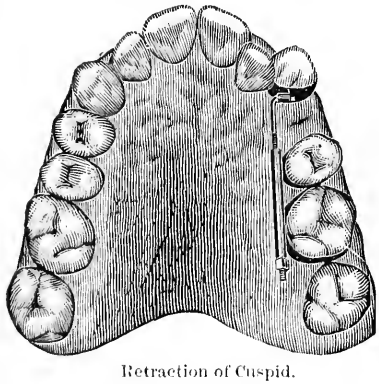
FIG. 31.



Re-enforced Anchorage.

"The backward movement of teeth in the line of the arch is accomplished by the appliance shown in Fig. 32. The second bicuspid and first molar are banded, and the tube of the heavy traction screw rigidly soldered to the bands. The cuspid to be moved is banded, and a short section of tubing soldered to it to receive the end of the traction screw.

FIG. 32.

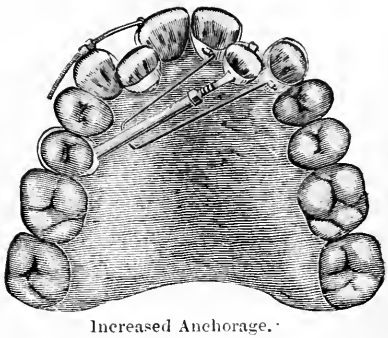


Retraction of Cuspid.

On turning the nut, traction is produced, and the cuspid pulled into place. The cuspid is kept from being rotated, while it is being moved backward, by means of the short tube accurately fitting the right angled end of the traction screw.

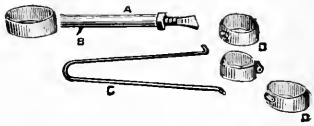
"Another outward movement of a tooth by means of the jack-screw, is shown in Fig. 33. The second bicuspid is made the principal anchorage, against which the base of the tube rests. The band encircling the lateral incisor has a slot cut in it to receive the end of the jack-screw. The anchorage is re-enforced by means of a wire loop, which hooks into tubes upon the adjoining central and cuspid, and is looped over a spur upon the body of the jack-screw tube. The central and cuspid cannot be pushed outward on account of this re-enforcement, and three teeth constitute the anchorage instead of one. The several parts of this appliance are shown in Fig. 34.

Fig. 33.



Increased Anchorage.

Fig. 34.



"Outward movement, as accomplished by another simple means, is as follows: A thin strip of band material is looped about the malposed tooth, the ends resting upon the labial surfaces of the adjoining teeth. To one end of this strip is soldered a tube placed vertically, while to the other end a similar tube is attached horizontally. Into these tubes the small traction screw is placed, being bent to conform to the shape of the arch, and being used in this case to push instead of pull. The parts of this device are shown separately in Fig. 35. The manner of retaining the teeth in position, after correction, is shown in Fig. 36.

Fig. 35.

Device for Outward Movement.

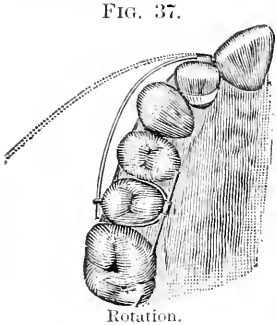
Fig. 36.

Retention.

"Rotation by this method, as in most others, is accomplished by the leverage and elasticity of a metallic bar or wire attached

to the tooth to be rotated, and then sprung around to some firmer tooth or teeth at a distance. Fig. 37 shows a lateral to be rotated, and the appliance in position by which it may be accomplished. The lateral is banded and tubed as shown in the cut. The second bicuspid is also banded, and to secure greater resistance, the two adjoining teeth are made to assist by means of a wire which passes through a tube on the palatine surface and rests against the first bicuspid and first molar. On the buccal side of this same band, the ends of the band material are shaped into a latch or hook, with which the rotating lever engages when it is sprung around. The several parts of this appliance are shown in Fig. 38. After the tooth is in position, it is retained by means of a short wire passing through the tube, and extending upon the central, as seen in Fig. 39. This wire is kept in place by a small pin, which is tightly fitted in a small hole drilled through both tube and wire, as shown.

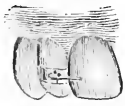
Fig. 37.



Rotation.

Fig. 38.

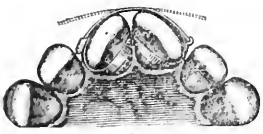
Fig. 39.



Retainer.

"When two teeth are to be rotated in opposite directions at the same time, as the central incisors, double rotation may be accomplished by one appliance, as shown in Fig. 40. Both teeth are banded, and a tube soldered to each band, one being horizontal and the other, vertical. A piece of piano wire is bent to a right angle at one end, and then placed in position as seen in Fig. 41. The tendency of the wire to straighten itself, will rotate both

Fig. 40.



Double Rotation.

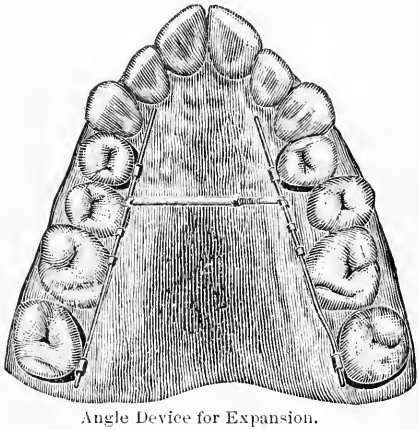
teeth at once. When in position they are retained by substituting a non-elastic gold wire for the piano wire.

Fig. 41.

Double Rotation.

"Expansion of the arch is accomplished by banding and tubing the first and last teeth of those to be moved, on each side, and connecting them by means of a wire passed through the tubes. The jack-screw is then placed in position across the arch from wire to wire. Collars, or short tubes, are soldered to the wires at intervals to keep the screw in proper position. The jack-screw may be moved forward or backward according to the varying requirements of the case. This appliance in position is clearly shown in Fig. 42."

Fig. 42.



Angle Device for Expansion.

Retention is always anticipated and provided for, by means of the tubed band, while the pin device for locking lever and tube together, is both novel and ingenious. Aside from these, the method contains so many ingenious modifications of previously known devices (as the screw and band), and is composed of parts so simple and direct in their action, that it must necessarily commend itself to all engaged in this line of practice.

The various parts of the Angle appliances may be obtained from the inventor, or from the dental supply houses.

COFFIN'S METHOD.

In a paper read before the Dental Section of the International Medical Congress, held in London, in August, 1881,

Mr. Walter H. Coffin explained his method of correcting irregularity of the teeth. The method was devised by his father, and had been in use by father and son for twenty-five years. It was termed the "Expansion Method," because in nearly all cases coming under their care, a certain amount of expansion had been found necessary in connection with other desired movements.

The construction of the appliance, and the principle upon which it acts, are exceedingly simple. The power is derived from the elasticity of piano-forte wire, attached in various ways to a vulcanite plate which covers the arch (in an upper case) and envelopes the posterior teeth on either side to give it firmness and fixedness in position. When it is desired to expand the superior arch, the wire is bent into the following form ∫∫, lying on top of the plate with the ends embedded in it.

To produce lateral expansion in the lower jaw, the form of the appliance is necessarily different. A simple vulcanite plate is made in horse-shoe form, fitting the gum and lingual surfaces of the teeth, and capping the molars and bicuspids. On the lingual surface of this plate, lie two pieces of piano wire suitably curved, with their ends imbedded in the rubber.

Each of these plates when completed, is sawn in two along the median line, thus allowing the tension of the wire to be increased from time to time, by spreading apart the sections of the plate.

The piano-forte wire used may be obtained from piano factories or from dealers in dental supplies. It is simply wire made from the best quality of steel, drawn to size through draw-plates. The quality of the steel, as well as the toughness of the wire, is greatly improved by the successive drawings to which it has been subjected. For ordinary cases Mr. Coffin recommends that the diameter of the wire be between three and four one-hundredths of an inch. A lighter or heavier number will yield respectively less or greater pressure.

In use it should not be annealed, but bent to shape as it comes. Mr. Coffin recommends that the wire be tinned after being bent to shape, to prevent oxidation in the mouth, but this does not appear to be necessary.

A wire suitably bent to produce expansion of the superior arch is represented by Fig. 43.

Fig. 43.

Coffin Spring.

The details of the construction of an expansion plate for the superior jaw, are as follows: From an accurate impression of the jaw and teeth, taken with plaster or modelling compound, a plaster model is obtained. Upon this a wax base-plate is fashioned, to cover all parts intended to be covered by the completed plate. The suitably bent wire is now further shaped so that it shall lie upon the exposed surface of the base-plate, and conform to it as closely as possible in outline. After the ends of the wire are attached to the base-plate by means of additional wax, a piece of tin-foil (No. 60) is slipped between the wire and the plate and its corners bent, so that the plaster when poured into the flask will grasp and remove it with the wire. The foil is placed there so that the plate will have a polished surface under the wire after vulcanization. The wax base-plate should now be smoothed with a spatula and flasked in the usual manner. In separating the flask, the wire and tin-foil will come away with the upper half, while the model will remain in the lower. After removing the wax and packing the rubber, the case is vulcanized, after which it is polished. The completed piece should now be properly fitted to the patient's mouth, and the rubber covering the masticating surfaces of the posterior teeth so filed and dressed that the cusps of the occluding teeth will all strike the rubber at the same time.

However many or few of the natural teeth be covered, the last ones in the arch must always be included, as otherwise they would elongate through non-occlusion, and thus seriously impair the usefulness of the masticatory apparatus.

After the plate has been fitted, it should be sawn in two with a jeweler's fine saw, the edges made smooth and slightly rounded, and the case introduced into the mouth.

It is desirable to have the patient wear the plate for a day without enlargement, after which, at intervals of a day or two, the tension of the wires should be increased by pulling the halves of the plate apart sufficiently to slightly increase the space between them. Only the fingers should be used in thus spreading the plate, for if pliers be used upon the wire for this purpose, the relation between the two halves may be so disturbed as to destroy the usefulness of the plate. The construction of the lower plate is substantially the same, only the wires lie against the plate in a continuous smooth curve, instead of being corrugated.

Figs. 44 and 45 represent an upper and lower expansion plate as described. For cases where expansion is not needed, but simply the moving of one or more teeth, Mr. Coffin uses a solid rubber plate, with wires so placed as to produce the desired movements. The construction of this form of plate is the same as those just described, with the exception of the shape and arrangement of the wires and the non-separation of the plate.

FIG. 44.

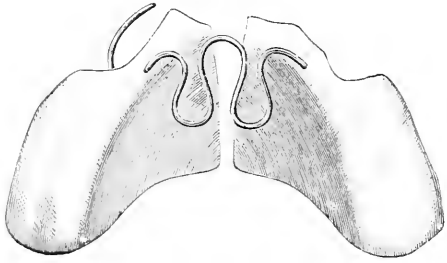
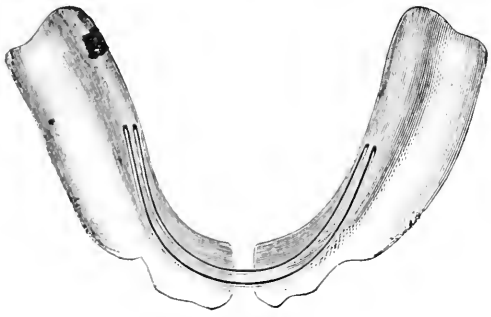


FIG. 45.



Coffin's Expansion Plates.

A single long piece of wire, bent at right angles near one

end and flattened at the other, is embedded at its flattened end into the plate; while the other end, and a long portion besides is free and lies in close apposition to the plate. Before the wire is attached to the wax base-plate, the plaster tooth representing the one to be moved should be cut away close to its neck and the bent end of the wire laid upon it so as to cover the entire diameter of the stub tooth. In this position it is vulcanized to the plate.

When the plate is introduced, the wire will have to be drawn back with an instrument or string, before the plate will go into position. Once in place, and the wire released, continuous pressure will be exerted on the malposed tooth. After the tension of the wire has been lessened by the moving of the tooth, it may be increased either by bending the wire where it enters the plate or by cutting it out and re-setting in a different position.

Another and very convenient way of lengthening the wires to follow the moving tooth, is to slip a section of platinum or German silver tubing over the end of the wire and soft-solder it in position.

Where a tooth is to be pressed outward, the wire is anchored in the palatal portion of the plate; but where a tooth is to be moved from without inward, the wire should be attached to that portion of the plate covering the buccal surfaces of the molars.

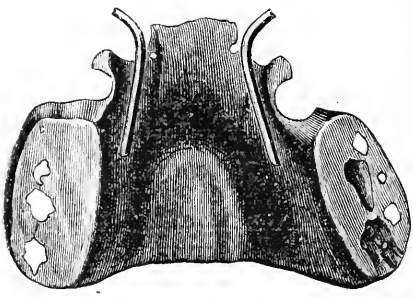
Rotation is accomplished by combining the two movements; that is, by having one wire on the palatine surface to press against one angle of the tooth, and another on the buccal surface to press against the opposite angle.

Two wires can be inserted to operate on two teeth at the same time, either in similar or opposite directions. Fig. 46 represents a plate made to press outward two lateral incisors.

Many modifications of the Coffin plate have been devised by different practitioners, some of which are shown in Part III.

The originator claims for his method and appliances, simplicity, ease of construction and inexpensiveness, almost universal range of application, perfect control of force applied and direct action, comparative painlessness from non-irritation of the soft tissues, perfect fixedness and least unsightliness, ease of removal for cleansing, and little interference with speech and mastication. All these claims must, we think, be granted; and in doing so, we probably accord it the highest place among the methods devised for the correction of dental irregularities.

FIG. 46.



Coffin Solid Plate.

TALBOT'S METHOD.

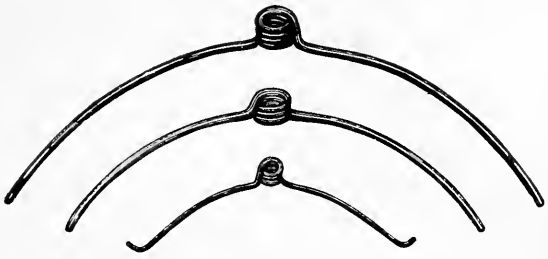
Dr. E. S. Talbot* has designed a modification of the Coffin piano-wire spring, which consists in converting it into a coil at some point of its length, thus adding, it is claimed, greater elasticity and a wider range of applicability. Unlike the Coffin spring it may be used without a rubber plate and without being permanently attached to any appliance. The coil is formed by bending the wire around a mandril firmly driven into the bench or properly secured in a vise.

The arms may be bent or cut to any length to suit the case in hand. They may be used in connection with a rubber plate, or with bands of gold or platinum fastened to the teeth with zinc-phosphate. With holes properly drilled in the bands or plate and the arms fitted into them, the spring will stay in position. When the spring is used without a plate it may be well to fasten the wire to some of the

*Talbot's "Irregularities of the Teeth," page 126.

teeth to prevent its being swallowed. Fig. 47 illustrates the coil spring in some of its forms. To prevent the spring from rocking in the mouth the coil is usually made to press over a button or post suitably placed on the plate for that purpose.

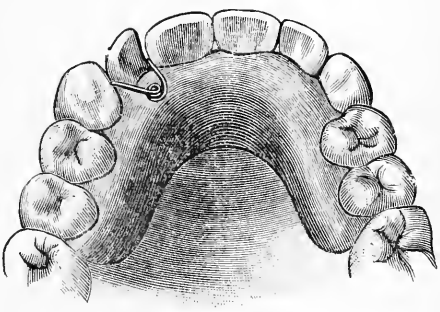
Fig. 47.



Talbot Coiled Springs.

Fig. 48 shows a case treated by Dr. J. F. Austin, in which the Talbot spring in a small form was made use of to press apart adjoining teeth to make room for rotating and bringing into place a lateral incisor that was malposed.

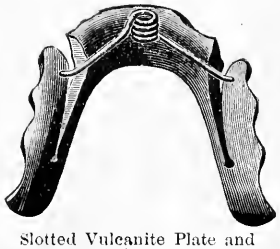
Fig. 48.



Coiled Spring in Position.

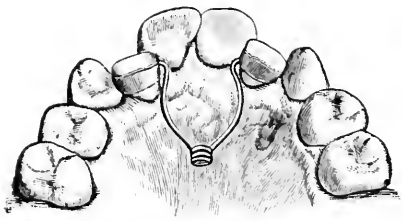
Fig. 49 represents the application and use of the coil spring in widening the lower arch. The plate is slotted after the Kingsley plan, in such a way that the partly separated portions may move independently of the rest of the plate. Near the free extremities of each of these tongues a hole is drilled to receive the ends of the coil spring, the coiled portion resting against the anterior portion of the plate. In this way the bicuspid teeth will be moved more rapidly than the molars.

Fig. 49.



Slotted Vulcanite Plate and Coiled Spring.

Fig. 50.



Coiled Spring and Platinum Bands.

An illustration of the use of the coil spring without a rubber plate is given in Fig. 50. In this case platinum bands were cemented to the laterals and the ends of the coil spring rested in small holes drilled in the bands for the purpose. The action of the spring forced the laterals out of lock, after which they were brought into proper position by means of other appliances.

The coiled spring, in many cases, possesses advantages over the plain spring because it can be effectively used where the other cannot. It is also more easily regulated as to tension, and can be readily replaced by a weaker or stronger one should the case require it.

PART III.

SPECIFIC FORMS OF IRREGULARITY AND THEIR TREATMENT.

While principles and methods may be well understood, illustrations of their application in certain forms of irregularity will be necessary in order that the student may properly comprehend their practical relationship.

So far as ease or difficulty of treatment is concerned, cases of irregularity are naturally divided into two general classes; in one the cases are brought to our notice as soon as the irregularity begins to manifest itself, while in the other the deformity is fully established and confirmed before presentation for treatment. In the first class, occurring usually in children, we have the advantages of easy movement and freedom from complications; while in the second, we have to contend with slow and difficult movement and a variety of unfavoring conditions.

For these reasons it is deemed advisable to treat of certain forms of irregularity, especially those involving the six anterior teeth of each jaw, under separate heads, according as they present before or after dentition is complete, for the treatment in one case will vary considerably from that required in the other.

CHAPTER I.

INCISOR TEETH ERUPTING OUTSIDE OR INSIDE OF THE ARCH.

Reference has already been made to the fact that normally the permanent inferior incisors erupt inside of the arch and posteriorly to the deciduous ones, while the permanent superior incisors erupt outside of their deciduous predecessors. From the limited space allotted to them, there is a stronger tendency to irregularity on the part of the lower incisors than there is on the part of the more favorably located superior ones, although the latter are also often found in a crowded condition, sometimes complicated with torsion.

So long as the inferior ones are within the arch, even though irregularly arranged, they will usually need no attention on our part until dentition is complete; and when that time arrives it will generally be found that nature has almost, if not entirely, corrected the condition.

So, also, where some of the superior incisors erupt slightly outside of the arch, they being still in line, with spaces between them, we need not interfere, for in most cases the force exerted by the lips and the erupting cuspids will bring them into normal position and relationship.

It not unfrequently happens, however, that from some cause a superior incisor is deflected in its eruption and appears inside of the arch, or that an inferior incisor is found to erupt outside of the arch. In either case, treatment is indicated as soon as the irregular tooth or teeth are sufficiently erupted to enable us to bring the proper force to bear upon them.

Where one or two of the superior incisors erupt inside of the arch, a very ready manner of bringing them out into line is by the use of the "saddle and inclined plane," as shown in Fig. 51.

Fig. 51.

Inclined Plane.

It is commonly made of silver plate, gauge 26, swaged in a single piece to cover all of the crowns of the inferior incisors and cuspids. At a point where the introverted upper tooth touches this plate, a piece of heavy silver, gauge 22, is soldered in an inclined position to the ridge of the saddle. With this appliance in position, the malposed tooth is readily brought forward into line, through the force exerted upon it in mastication. Where more than one tooth is to be moved, corresponding inclined planes are attached to the saddle for each one.

To insure a close fit and stability for the piece, it is well to scrape slightly the neck of each plaster tooth on the model, both on the lingual and labial aspect, before casting the die. With the appliance properly constructed, so as to bind upon each tooth at its neck, it will usually retain its position during the ten or fifteen days necessary for bringing one or two teeth into place.

To avoid the necessity of removal for cleansing and the possible non-replacement of the appliance by the patient, as well as to secure it in position more effectually, the writer has been in the habit of cementing it to the teeth with phosphate of zinc cement, in the same manner as crown and bridge-work is attached.

Two principal objections have been urged against this appliance: one, that by thus opening the bite, the posterior teeth will elongate; the other, that the patient may avoid biting upon the plane. These objections have no real validity, as is shown by actual experience.

The short time that the bite is kept open is not long enough to permit of any perceptible elongation, and the patient must and does bite upon the plane in mastication, because it is the only point where occlusion is possible.

In cases where a lower incisor is locked out of the arch by a superior one biting inside of it, both teeth can be moved in opposite directions and brought into line by means of an appliance devised by the author many years ago. It is constructed as follows: A band of thin platinum plate (No. 29, Am. gauge) is bent to encircle and fit the protruding lower incisor, and the ends soldered. A piece of ordinary gold plate is then bent double to form the plane, and spread apart at its ends to grasp the band on the lingual and labial surfaces, to which it is soldered. It is next placed upon the tooth to see that the adjustment is correct, removed, lined with phosphate of zinc, and pressed permanently into position. If the teeth are in close contact it is well to allow the fixture to be worn a day previous to cementing, for then the teeth will have been pressed apart and the replacement with cement will be more easily accomplished. The cement not only lines the band, but fills up all the space between the plane and the tooth, thus giving greater resistance and strength in biting. It is shown in position and separately, in Fig. 52. Its advantages are its small size and absolute fixedness. When the correction has been accomplished, it will be necessary to cut the band in order to remove it.

Fig. 52.

Fixed Plane.

Another plan of accomplishing the same end is that devised by Prof. C. N. Peirce. He simply attaches ligatures to several or all of the lower incisors, and makes these fast to the molars on either side. The ligatures being attached and drawn tight while dry, will, under moisture, contract and draw the incisors inward. This operation is continued until the lower incisors reach a position inside or back of the malposed superior ones. The ligatures are then removed, and the lower teeth, in gradually resuming the position they formerly occupied, will carry the inlocked superior ones with them.

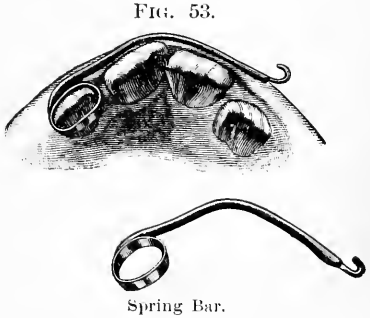
Where, for any cause, it is desirable to confine the means

of correction to the jaw in which the irregularity exists, as for instance where the superior laterals are inlocked, a simple plan is to take a piece of platinized gold, about one-eighth of an inch in width and long enough to more than cover the four incisors, and punch or drill four holes in it, two opposite each of the laterals. The bar being laid in position on the labial surfaces of the centrals, the laterals are securely ligated to it, the thread passing through the holes. The spring of the bar and the contraction of the moist ligatures, will move the laterals into position in a short time, the ligatures being renewed every two or three days.

A more satisfactory way of performing this operation, is to solder one end of the bar to a platinum band made to encircle one of the laterals and attached to it by zinc cement. Arranged in this way, the bar has but one free end, which is the more readily ligated to the other lateral.

Fig. 53 illustrates an appliance of this character, that was used to bring out into position two superior laterals in the mouth of a girl ten years of age. The case was complicated by one of the centrals being slightly turned upon its axis.

FIG. 53.



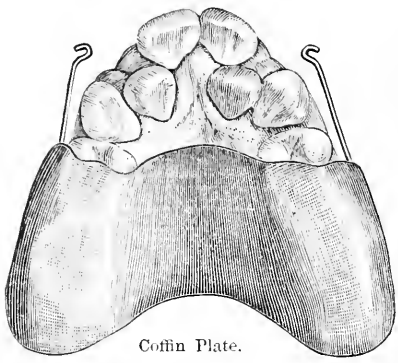
Spring Bar.

A platinum band or collar was made to fit the right lateral, and to its labial surface was soldered one end of a bar of spring gold, long enough to extend over the centrals and cover the opposite lateral. The bar was converted into a hook at its free end, and was so shaped that in its course it touched only the prominent edge of the twisted central. The band was then cemented to the right lateral, and a section of small rubber tubing passed under the left lateral and caught in the hook. The appliance thus operated in two ways: First, to bring the

laterals out into line; and next, to press backward and inward the protruding corner of the central.

Another way of securing the same result is by the use of a Coffin plate and suitably shaped extension wires, as shown in Fig. 54.

Fig. 54.



Coffin Plate.

The rubber plate is made to cover the arch and enclose several bicuspids or molars on each side. In each of the buccal portions of the plate a piece of piano wire is imbedded, which extends forward clear of the teeth and terminates in a curve or hook opposite the tooth to be moved outward. A section of rubber tubing is slipped over the tooth and caught upon the hook. The elasticity of the rubber, added to the spring of the metal, will rapidly draw the tooth outward provided there is sufficient space in the arch to accommodate it.

As already stated, slight spaces existing between the superior incisors when recently erupted need give us no concern, provided they are in the normal line of the arch; but it often happens that in addition to the spacing, one or more of them is, to a greater or less extent, turned upon its axis, as shown in Fig. 55.

Fig. 55.

Torsion with Space.

Fig. 56.

Torsion with Overlapping.

In other cases the teeth may be in contact, while one of them is twisted and overlapping its neighbor, as shown in Fig. 56. In either case it is quite probable that the cutting edge of the turned tooth will occlude with the corresponding surface of the one in the opposite jaw at an

angle, and thus either prevent full eruption of one or the other of the teeth, or temporarily open the bite and favor undue elongation of posterior teeth.

Both of these forms of irregularity should receive immediate attention, for at an early age correction is easily accomplished. Were the conditon to remain unchanged, it would necessarily become more complicated from partial closure of the space caused by the lateral pressure that would be exerted during the eruption of neighboring teeth.

Rotation of these teeth, as well as of others, may be accomplished by one of the many methods described in Chapter VI.

CHAPTER II.

DELAYED OR MAL-ERUPTION OF THE PERMANENT CUSPIDS.

The third molars excepted, the cuspids are usually the last teeth of the permanent set to erupt, and they almost invariably make their appearance outside of the arch. When there is room in the arch for their accommodation and they erupt directly outside of it, we may feel assured that in due time they will find their way into place unaided. Where, however, they erupt over the lateral incisors, as is sometimes the case, and these incisors are in consequence being forced inward from their true position, it becomes necessary for us to interfere and endeavor to draw the cuspids toward their proper places. This is usually not a difficult matter when the cuspid crown is far enough erupted to enable us to apply pressure upon it. In such a case, by cementing a Magill band to the cuspid and another to the second bicuspid or first molar, each having a pin or hook attached to its buccal surface, a rubber ring extending from hook to hook will, in a short time, draw the cuspid back to a position opposite the space it is to occupy as illustrated in Fig. 78.

It sometimes happens, however, that the cuspids are tardy in their eruption and fail to assume their positions in the arch at the time they are needed to complete the row and prevent the incisors and bicuspids from encroaching upon the space the cuspids are to occupy. In such cases it is generally advisable to hasten their eruption by the application of tractile force in some manner. Where one-half of the crown is through the gum we can attach to it a Magill band with a pin, hook or other projection upon it, and by its assistance readily apply power to the tooth.

The author has had several cases where elongation of the

cuspid was called for, when only the cusp of the tooth was visible through the gum. Here, the application of a cemented band was out of the question, and attachment to the tooth had to be gained in another way. The difficulty was solved by tying a silk ligature in a half knot, passing it over the projecting cusp, and then with a small, flat plugger, forcing this ligature up under both gum and alveolus until it encircled the neck of the tooth, when it was drawn tight and made fast with a surgeon's knot. A very small gold ring, with a centre only large enough to admit of the passage of silk floss, was then slipped over one of the ends of the ligature and tied so that it would lie upon the labial face of the tooth near the gum. This ring was allowed to remain without change until the tooth was drawn into position. A delicate vulcanite plate was constructed to fit the arch, and extend into the space between the lateral and first bicuspid. At this latter point the plate was thickened until it was nearly on a level with the cutting edges of the adjoining teeth, and made concave on its most prominent part. A rubber spur was also formed on the plate, in a line with the cuspid and space. The plate being in position, a rubber band was passed over the spur and drawn tight to the ring on the tooth by means of a ligature, the band in its course resting in the notch of the elevation on the plate. By this arrangement no pain was inflicted except that incident to forcing the ligature into position under the gum, while power was exerted in a nearly direct line with the long axis of the tooth, and in a gentle, continuous manner.

Another and most excellent plan of securing attachment to a partially erupted cuspid, is that devised by Prof. J. F. Flagg. It consists in screwing a gold ring-bolt or screw-eye into the point of the cusp. The screw-eye can be made by soldering a small gold ring to the end of a section of threaded gold wire. After the correction is accomplished, the screw is removed and the hole filled with gold.

If mal-position of an erupting cuspid should be compli-

cated with more or less torsion, the correction of the latter will be best accomplished after the tooth is nearly or quite in position.

When a superior cuspid erupts inside of the arch, it may either be forced outward by a Coffin plate and spring, or it may be drawn outward by one of the several methods mentioned for similar operation upon the incisor teeth.

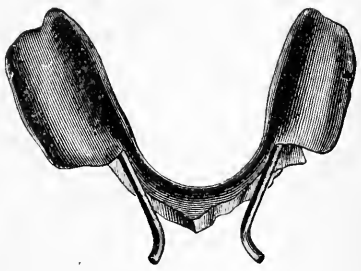
The difficulty of gaining a firm hold upon a cuspid tooth, owing to its round and conical form, may be overcome by encircling it with a Magill band. To this any desired attachment can be made.

CHAPTER III.

INCISOR TEETH SITUATED OUTSIDE OR INSIDE OF THE ARCH AFTER DENTITION IS COMPLETE.

Irregularities of this character will require much the same treatment as is given to similar cases occurring during dentition, but the attendant difficulties will be greater, owing to the greater density of the alveolar structure and the presence of all the teeth, making the obtaining of space more difficult. In the lower jaw, the irregularity in most cases is confined to one or two teeth, standing either anteriorly or posteriorly to the line of the arch. If they are located posteriorly, and the extraction of one of them be not indicated, room should be made (if it does not exist) by pressing apart the neighboring teeth. After this is done they may be conveniently forced into place by means of a Coffin plate, constructed as shown in Fig. 57.

FIG. 57.



Coffin Plate for Lower Incisors.

Or, if it be desired to interfere less with the tongue in speech, the wires, made to describe a slight curve and without angles, may be anchored in the plate on the outside. Their free ends may then be drawn down and made fast to the in-lying teeth, either by means of a silk ligature or rubber ring, as shown in Fig. 54.

Where it is desired to move outward a single incisor, and at the same time create space for its accommodation, an excellent method for its accomplishment is that devised by Dr. A. E. Matteson.*

* *Dental Cosmos*, Vol. XXX, p. 68.

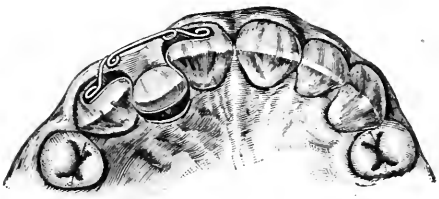
The apparatus consists of two separate parts, a narrow ribbon of thin gold or platinum, and a coiled spring of piano wire. The ribbon is cut of sufficient length to pass around the in-lying tooth, and over the labial surfaces of the two adjoining ones. The spring is made from piano wire, No. 14 or 16, and bent to the shape shown in Fig. 58.

Fig. 58.

Matteson Coiled Spring.

After the spring is constructed, the ribbon is placed in position and the spring, with its ends drawn closer together by means of a ligature, is laid upon it, and the points where the ends of the spring touch the ribbon marked with a pencil or sharp instrument. The ribbon is then removed and a hole punched near each end opposite the marks, after which it is again properly placed upon the teeth, the ends of the spring placed in the holes, and the restraining ligature severed. Pressure begins at once and continues uninterruptedly until the tension is spent and the teeth moved. The appliance in position is shown in Fig. 59.

Fig. 59.



Matteson Appliance in Position.

Should the tension of the spring not be sufficient to move the tooth entirely into place, the appliance should be removed, new holes punched in the ribbon nearer its centre, and reapplied. The case of irregularity shown, was corrected by the use of this appliance in ten days.

Where a ribbon is inadmissable on account of a close bite, Dr. Matteson substitutes a piece of gilling twine, one end of which he fastens to one eye of the spring by means of a slip-knot, and the other, after passing around the tooth to be moved, is secured to the other eye. The ligature is now cut, and the spring operates as in the previous instance. Dr.

Matteson says: "By the use of a longer compound spring, several teeth may be brought into line at the same time. For example, where the lower incisors are in a 'jumbled' condition, the ribbon or ligature may be woven in and out among the proper teeth in such a way that when the power of the spring is exerted some teeth will be pushed apart to make room for others which are being pulled into place."

Another manner of using the metal ribbon for drawing outward an inlocked incisor, and at the same time creating space for its accommodation by pressing apart the adjoining teeth, is that suggested by Prof. Angle and noticed in the description of his method. The ribbon being of sufficient length to pass back of the inlocked tooth and rest slightly upon the labial surfaces of the adjoining teeth, two short tubes are soldered to it, one at each end. One of these tubes is set vertically and the other horizontally. A piece of steel wire, bent at a right angle at one end, and thread-cut and provided with a nut at the other, is made to engage with the tubes, the bent end slipping into the vertical tube and the other passing into the horizontal one, with the nut resting against its inner end. By unscrewing the nut the ends of the ribbon are forced apart and the desired movements accomplished. Fig. 60 represents the appliance in position, and Fig. 61 the separate parts of which it is constructed. In this device the direct power of the screw is used to furnish the necessary pressure.

Fig. 60.

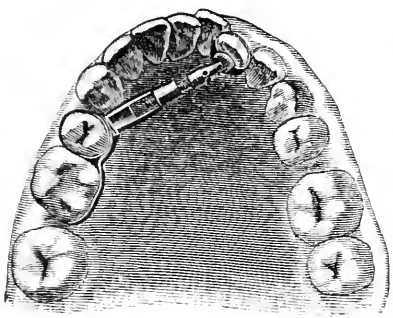
Fig. 61.

The credit for first devising an appliance that would draw a tooth outward into line and at the same time create space for it by pressing apart the adjoining teeth, is probably due to Dr. J. N. Farrar, whose device and description may be found in the *Dental Cosmos*, Vol. xxvi, page 672.

A lower incisor, when locked inside of the arch by the

over-lapping of its neighbors, is often so firmly held in its mal-position that all ordinary means will fail to move it unless space is first provided for it by lateral pressure. This being sometimes difficult of accomplishment, the direct power of the jack-screw may be taken advantage of in such cases to overcome the difficulty, as shown in Fig. 62.

Fig. 62.



Jack-Screw Forcing Out Inferior Lateral.

The patient in this case was at least twenty-five years of age and the lateral incisor tightly inlocked. A platinum band was constructed to fit the lateral, and on its lingual surface was soldered a tongue of heavy platinum, so formed that it would lie in contact with the tooth when the band was in position. Into this tongue, near its free end, was drilled a counter-sunk hole nearly deep enough to pass through the metal. On the opposite side of the mouth the second bicuspid was similarly fitted with a band, to which was soldered a strip of platinized gold long enough to cover the lingual surface of the adjoining molar. By this means the molar was made to assist in resisting the force to be applied to the lateral. The bicuspid band was also re-enforced by an additional piece of heavy platinum soldered to it at a point diagonally opposite to the lateral. Into this latter piece a horizontal slot was drilled with an engine-bur, sufficiently deep and long to receive the fish-tail end of an ordinary nickeled-steel jack-screw. After both bands were cemented in place, the jack-screw was placed between them with the flat end in the bicuspid band and the point resting in the counter-sunk hole of the lateral band. The patient increased the tension of the screw from day to day by turning, and in two weeks time the tooth was in line. It was held there

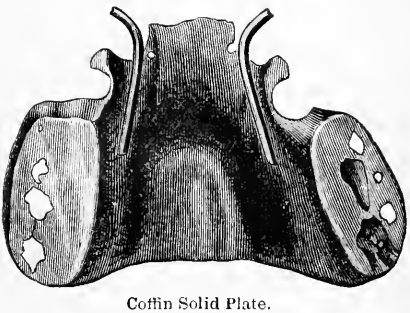
until it became firm by means of platinum binding wire woven about it and its neighbors.

In the upper jaw, where single incisors stand within the arch, they may be forced forward into line by some of the appliances just described for use in the lower jaw, such as the Matteson spring and the jack-screw, or by those referred to for bringing out into line upper teeth during eruption, such as the inclined plane, and the band and bar.

There are methods, however, of dealing with cases of this character in adult life, that are preferable to those already described.

One is by means of the Coffin plate as shown in Fig. 63, and constructed as described on page 103. The advantages of a plate of this character, are its inconspicuousness and great power.

Fig. 63.



Coffin Solid Plate.

The only difficulty in the use of this form of Coffin plate, met with by the author, has been where the teeth to be moved, although inside of the arch, stand perpendicularly or incline slightly forward. In these cases the free ends of the wires, after being pressed up into position on the teeth, are frequently thrown down toward the cutting edge by the force of the spring operating upon an inclined surface. Where great inconvenience arises from this cause it may be remedied by cementing a narrow platinum band about midway of the crown of the tooth to be moved, and placing the end of the wire spring above it.

Another plan of moving outward any or all of the superior incisors, is by means of a plate constructed after the pattern of Fig. 64.

It is made of rubber, and has inserted in it a half-round

gold wire, with the flat side toward the teeth. The wire passes out from the plate on one side at any point where there may be space for it, and following the outline of the teeth, but separated from them by a space of an eighth of an inch or more, re-enters the plate at some convenient point opposite. When in position, pressure is brought to bear upon the teeth to be moved by means of rubber bands passing over the gold wire and around such teeth.

Fig. 64.

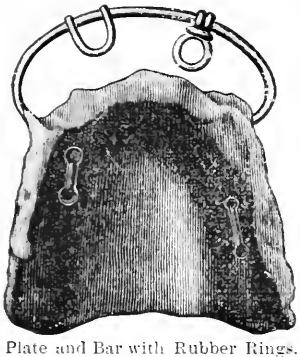


Plate and Bar with Rubber Rings.

The cut shows the manner in which these bands are applied. The one with the single fold to encircle the tooth, is used where less traction is desired: and the other, with the double fold, will have to be used to bring the tooth entirely into contact with the wire. To prevent, as far as possible, the bands from slipping off over the cutting edges of the teeth, the wire should be so arranged in relation to the plate that when in position it will be on a line with the necks of the teeth, thus enabling the bands to pull upward as well as outward. Should the rubber bands still show a disinclination to remain on the teeth, they may be held in place by ligatures tied around their necks and secured to the rubber on the palatine side.

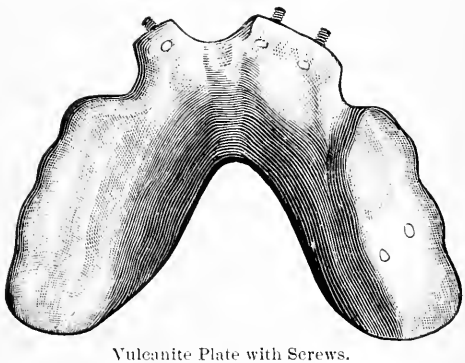
The plate is secured in position by being ligated to a posterior tooth on each side, holes being drilled through the plate at points suitable for the purpose. If, after the teeth are moved out far enough to touch the wire, it be desired to move them still farther, the bar can be stretched by beating it with a riveting hammer over the horn of a small anvil. Or, the wire may be removed from the plate and a longer one inserted.

The appliance is equally effective in drawing forward either one, two or all of the incisor teeth at the same time.

Prof. R. B. Winder suggests the soldering of small pieces of gold to the bow wire directly opposite each tooth to be moved, and occasionally at intermediate points. By the aid of such cleats, he says, the rubber bands are more easily attached and removed, and traction can be made in an oblique direction as well as forward.

Still another method, both simple and effective, of moving an incisor outward into line, is by a combination of metallic screws and a vulcanite plate, as shown in Fig. 65.

Fig. 65.



Vulcanite Plate with Screws.

A thin vulcanite plate is constructed to cover the roof of the mouth and cap the bicuspids and molars; opposite the tooth or teeth to be moved, the plate is allowed to come down to their cutting edges. Directly opposite the centre of each of these teeth, a hole is drilled entirely through the plate to receive a piece of screw wire long enough to pass through and project a little beyond it. In springing the plate into position the slightly projecting ends of the screws will press against the teeth and they will be moved forward. A half turn of the screws every day will soon force the teeth into position.

The originator of this device is unknown, but it was first brought to the notice of the author by Prof. Thos. Fillebrown.

Where a single incisor in the upper or lower jaw is situated either inside or outside of the arch, and where there is room for its accommodation and no obstacle exists to prevent it from occupying its normal position, it may sometimes be brought into place by the simplest of all means

and without the making or wearing of any appliance whatever.

All that is needed is to instruct the patient to exert pressure upon the tooth, with one of his fingers or thumbs, in the direction in which it needs to go. The pressure thus exerted should be great enough and continued sufficiently long to cause the tooth to feel uncomfortable and be repeated a half dozen or more times daily. The method is a slow one and somewhat uncertain as the result will depend entirely upon the zeal and faithfulness of the patient, but notwithstanding these limitations, it has been found thoroughly efficient in numberless cases, as many practitioners can testify. The author has adopted the plan frequently with charity patients and in most cases with satisfactory results.

When an incisor tooth in the lower jaw stands outside of the arch, the malposition is usually due either to its having been forced out of place by a superior one occluding back of it, or to unusual crowding on the part of its neighbors. In the first instance, the correction of the occlusion of the superior tooth will usually press the lower one into its proper place, while in the second instance, it will be necessary to consider the advisability of extracting one of the crowded teeth to afford room. If such an extraction be deemed best, the case will be greatly simplified and the mal-posed tooth can be brought into line by some one of the means shortly to be described for drawing inward the superior incisors.

If it be deemed inexpedient to extract one of the crowded teeth, room will have to be provided either by expanding the arch or by extracting a tooth or teeth back of the cuspids.

In considering the matter of expansion of the arch, it should be borne in mind that the enlargement of one arch may also necessitate the expansion of the other in order to preserve the normal occlusion. If both jaws will admit of

it to advantage, it may be the best plan to pursue, although it will necessarily increase the labor and difficulty of the operation. Generally, if the occlusion and facial expression be satisfactory, it will be far better not to disturb the general relation of the teeth, but rather to extract one or more of the bicuspids or molars. After any of the posterior teeth have been extracted, the anterior ones can be moved apart or backward and the irregular tooth brought into place. A simple and excellent way of moving backward one or more incisors, especially in the lower jaw, is that devised by Dr. Kingsley and shown in Fig. 66.

FIG. 66.

Kingsley's Vulcanite Plate and Rubber Bands.

The appliance is a simple vulcanite plate made to fit the lingual surfaces of the ten anterior teeth and the adjacent gum. A portion of the plate lying immediately back of the tooth or teeth to be moved is cut away to make room, and then slotted to accommodate the rubber rings that are to act upon the teeth. By adapting the diameter and width of the rings to the force desired, any degree of tension can be brought to bear upon the outstanding teeth. Any of the inferior incisors, after being brought into line, will usually be retained in place by the occlusion of the superior teeth, but where this is not the case, they may be retained by means of platinum binding wire woven about all of the incisors at or near their necks, or they may be securely held by means of a ribbon of thin gold fitting the lingual surfaces of the incisors, to which is soldered a platinum band to encircle each tooth that has been corrected. The piece is set with phosphate of zinc as a lining to the bands.

For drawing or forcing into line any of the superior incisors standing outside of the arch, a variety of methods is at our disposal. In the upper jaw the extraction of one

or more incisors to provide room for other outstanding ones is, except in rare cases, not to be thought of, although, as just stated, in the lower jaw extraction may often be advantageously resorted to. The greater conspicuousness of the superior incisors, and the difference in size between the centrals and laterals would cause the absence of any one of them to be most noticeable. Rare cases occur, however, in which such extraction is justifiable, as described on page 43, but a wise discrimination must be exercised in regard to the matter, as otherwise a greater deformity is likely to be created than the one already existing. Where space is needed in the arch for the outstanding tooth or teeth and expansion of the arch is not indicated, we may obtain it by extraction back of the cuspids, or where the lack of space is slight in amount it may be secured by simply exerting pressure upon the adjoining anterior teeth. A simple way of producing this pressure is by the use of compressed wood, as described on page 69.

Another plan is by means of a vulcanite plate to which are attached gold or steel wires so arranged that their free ends, when drawn together and inserted in the space intended to be widened, will press the adjoining teeth farther apart.

Still another, without the use of a plate, which the author has found very effective, consisting of platinum bands attached to the teeth to be moved, with a piano-wire spring acting between them, is described and illustrated on p. 161.

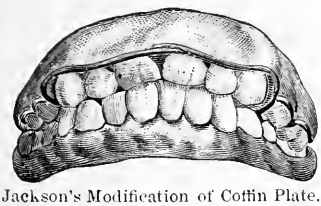
Dr. Farrar recommends for the same purpose a delicate jack-screw with crutch ends to fit the teeth to be separated.

Other ways of accomplishing the separation will suggest themselves to an inventive mind.

After the desired space has been obtained, the tooth may be brought into place by means of a Coffin plate with a wire attached to its buccal portion, extending forward in a curved line and resting near its free end upon the projecting tooth. Bending the wire inward from time to time will keep up the pressure upon the moving tooth.

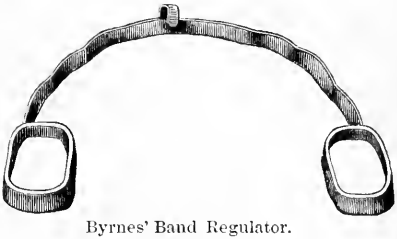
To secure additional power in such cases, Dr. V. H. Jackson* has modified the above appliance by inserting two wires in the plate, one on either side, and allowing the free ends of each to rest upon the tooth to be moved as illustrated in Fig. 67. Dr. B. S. Byrnes† presents two methods, both simple and ingenious, for bringing into line an outstanding

FIG. 67.



Jackson's Modification of Coffin Plate.

FIG. 68.



Byrnes' Band Regulator.

incisor tooth. One, as shown in Fig. 68, consists of two gold or platinum bands made to fit suitable posterior teeth intended for anchorages, and connecting them with a gold ribbon, nearly long enough to extend around the labial surfaces of the intervening teeth. At some point in the length of this ribbon a gold hook is soldered to engage with the cutting edge of one of the anterior teeth and thus prevent it from slipping up on the gum. By forcing the bands over the teeth intended to receive them pressure is at once brought to bear upon the tooth to be moved. When the elasticity of the wire has spent itself, it should be removed, a small piece cut from its length, soldered and re-inserted. This may be done as often as necessary until the tooth is brought into position. Additional pressure may also be obtained by placing pieces of elastic rubber between the ribbon and the moving tooth.

The second method consists in making a band to fit the outstanding tooth and another for some posterior anchor tooth. These bands are connected by a strip of thin cor-

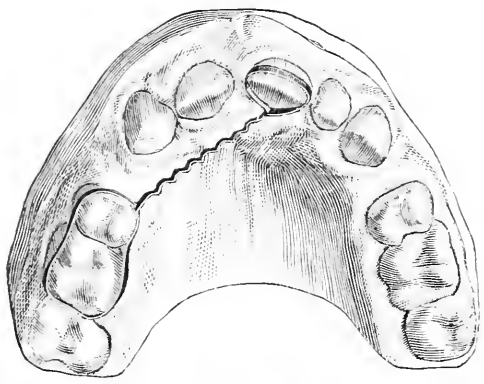
* *Dental Cosmos*, Vol. XXX, p. 510.

† *Dental Cosmos*, Vol. XXVIII, p. 278.

rugated gold plate. When ready for use the bands are slipped over their respective teeth and traction is exerted by the elasticity of the corrugated metal. The closeness of the corrugations will regulate the force desired, which may be increased at will by pressing the folds closer together. Fig. 69 shows the appliance in position.

The author's usual plan in such cases is to solder pins or hooks at suitable points on the two bands and cement these in position. They are then connected by means of a rubber band extending from tooth to tooth and caught over the projections on the bands as shown in Fig. 70.

FIG. 69.

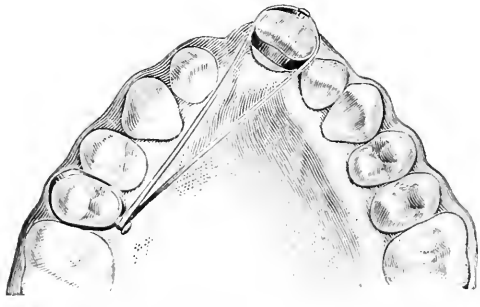


Byrne's Corrugated Band.

By cutting the rubber bands from French rubber tubing of different diameters, any amount of tension may be produced.

Dr. Kingsley* has suggested another method of producing the same result by the combination of gold wires with a rubber plate as shown in Fig. 71.

FIG. 70.



Magill Bands and Rubber Rings for drawing in Central.

One end of the long wire is imbedded in the plate while the other is converted into a hook. A short wire similarly shaped and secured passes between certain

* Oral Deformities, p. 87.

posterior teeth on the opposite side and comes forward to nearly meet the first one. By connecting the two with a rubber band, pressure is brought to bear upon the prominent tooth which is gradually forced inward into line.

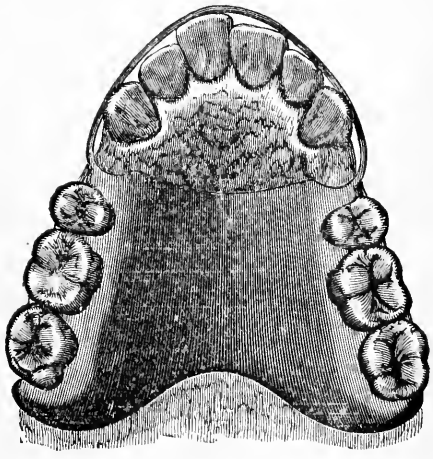
Another method of Dr. Kingsley's for pressing in one or more of the anterior teeth is shown in Fig. 72. It consists of a rubber plate with gold bow-spring attached.

He says:* "The plate was accurately adjusted to fit and catch between the bicuspids and molars. The gold wire in front was elastic and springy. It was bent so as to impinge upon the incisors (or incisor), then caught in front of them, pulled back, and sprung into place. As fast as the reduction was accomplished, the wire was bent at the sides where the teeth had been extracted, and also contracted."

Fig. 71.

Kingsley Plate.

Fig. 72.



Kingsley Plate.

Protrusion of a single incisor or more may also be corrected by means of a fixed appliance with the screw as the operating principle, as in the methods of Drs. Patrick and Farrar.

In using the Patrick appliance for irregularities of this character,

* Idem, p. 109.

the adjustable loop-bands and bow-spring are placed in position and properly secured. The slide "H" is then made to rest against the projecting tooth, the hook "I" is caught over the cutting edge of some adjoining tooth and tension is produced by turning the screws "D." (See p. 85.)

Superior incisor teeth, after being forced backward into line, may be retained most simply by means of the platinum band and gold bar as shown in Figs. 13 and 14, (pp. 79 and 80.)

It is inconspicuous, occupies little space, and holds the tooth or teeth immovably.

When sufficient time has been allowed for the tooth to become firm, (never less than six months) the retainer should be carefully removed as described on page 91. For a few months afterward the patient should be seen once a week, in order to ascertain whether the tooth is remaining in its new position. Should it manifest a tendency to recede, the retainer must again be placed in position and kept there for a further period of three months or more.

By thus carefully watching a case after its supposed completion, we may often avoid the loss of some of the ground we have gained.

CHAPTER IV.

CUSPID TEETH SITUATED OUTSIDE OR INSIDE OF THE ARCH.

Of the various forms of irregularity that present for treatment, none perhaps is more common than that in which the cuspid teeth are located outside of the arch. The cause most frequently responsible for this condition is the premature extraction of the temporary cuspids, although it is often caused by delayed eruption of the permanent ones, and by the lack of accommodation a small arch sometimes affords for the full complement of teeth. The cuspids (superior) being among the later teeth to appear, often find their territory pre-occupied by the earlier arrivals. Frequently, though not always, the mal-position of the cuspids is associated with like mal-position of certain neighbors, usually the central and lateral incisors. The irregularity of these adjoining teeth is, in most cases, brought about by the pressure of the cuspids in their attempt to occupy their places; for, previous to their appearance there is no inducement, if the occlusion be normal, for the incisors to vary much from their true positions. The fact should not be overlooked that all teeth in erupting, are impelled by a strong hidden force to seek their proper positions in the line of the arch, and in no teeth is this persistence more plainly or powerfully exhibited than in the cuspids.

The conditions being favorable each tooth will naturally assume its place in line, and should obstructions interfere it will strive to overcome them; but the cuspid teeth will, if necessary, exert a power far exceeding that of any of the other teeth in their efforts to gain their proper positions in the arch. To this end incisors are often disarranged, and bicuspids forced inward or outward. This wonderful force

exerted by the cuspids, may well be illustrated by a case which occurred in the practice of the author many years ago:—

The patient was a young lady about fifteen years of age, in whose upper jaw a cuspid had erupted outside of the arch, causing projection of the lip. All of the other teeth were regular, but the bicuspids and molars on the affected side were somewhat in advance of their true positions, and there was consequently very little space in the arch for the accommodation of this cuspid. The first molar on the same side was badly decayed, so it was decided to extract it as a preliminary to making room for the cuspid. An appliance was then attached to the second molar and second bicuspid, intended to draw the latter tooth backward. The patient left with this fixture in position and did not return until eighteen months later, when it was noticed that both bicuspids had moved backward and the cuspid occupied its normal position in the arch. It transpired that the appliance, having caused some pain, was removed by the patient two days after it had been placed in position. The correction of the irregularity had been entirely accomplished by the cuspid forcing its way into place and crowding the bicuspids backward in the effort.

To obtain space for the accommodation of the cuspids when they are situated outside of the arch, we usually have to decide between the enlargement of the arch and the extraction of one or two teeth posterior to them. If the upper arch is contracted and will admit of expansion to advantage, it may be done by one of the methods described in Chapter VII. of this part; but if this be not indicated, we will have to decide upon the extraction of a bicuspid or molar in order to obtain space.

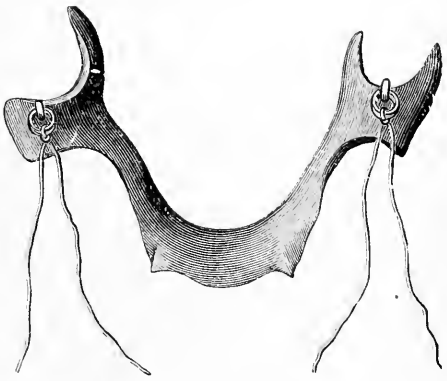
A careful consideration of the rules governing extraction, on pages 45 and 46, will greatly assist the operator in deciding which tooth to extract.

It very frequently happens that the space in the arch in-

tended to accommodate the cuspid is nearly, but not quite, sufficient. In such cases, slight additional space may generally be gained by pressing apart the adjoining teeth with the fixture shown on page 161.

Room having been provided, the cuspid tooth may be brought into place by one of several methods that are equally effective in the upper and lower jaws. Outstanding cuspids are usually situated a little in advance of their normal positions, so that in bringing them to place we must exert force in a backward as well as inward direction. Dr. Kingsley, in his work,* shows a neat and effective appliance for bringing inferior cuspids into line. It is illustrated in Fig. 73.

Fig. 73.



Kingsley's Vulcanite Plate and Rubber Bands.

It consists of a narrow vulcanite plate, fitted to the lingual surfaces of the teeth and the adjacent portion of the ridge. In the posterior portion of the plate, gold hooks are inserted over which rubber rings are caught, drawn forward and tied to the cuspids.

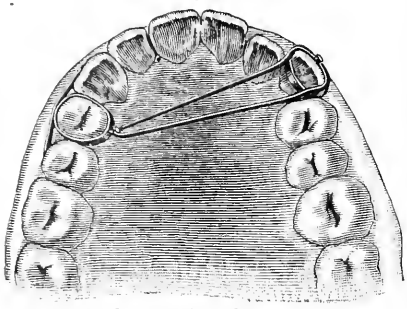
Another simple way of bringing about the same movement, is by means of the Coffin plate with the wire or wires attached to the buccal portion and extending forward until their free ends rest upon the teeth to be moved. Ordinarily, the pressure to be exerted by them would be inward only; but by bending their ends into the form of partial hooks, so as to engage with the mesial surfaces of the teeth, an additional backward pressure is obtained.

Sometimes a cuspid may be drawn into position by so simple a means as that shown in Fig. 74.

* Loc. cit.

In this case a platinum band, with a pin on its labial face, was cemented to the outstanding cuspid. To the first bicuspid on the opposite side was fitted a similar band with a small gold hook on the palatine surface and a bar of platinized gold on the buccal surface long enough to extend to and rest upon the adjoining cuspid and second bicuspid. This provided the resistance of three teeth, whilst attachment was made to but one. A light vulcanite plate was made to cover the arch, so as to protect it from the irritation of the rubber ring, which was stretched from band to band. The operation of bringing the tooth into line was somewhat slow, occupying some four or five weeks time, but the object was satisfactorily accomplished.

FIG 74.

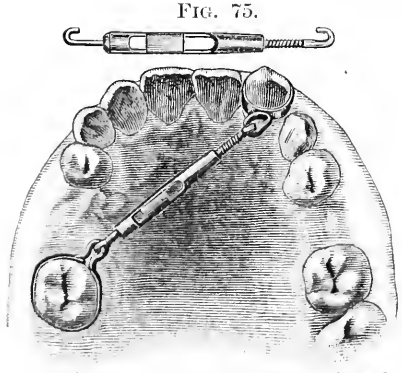


Increased Anchorage.

In most cases, however, greater force than that exerted by a rubber band will be necessary to draw a cuspid into place, especially if it be large and firmly implanted. In such event the power exerted by a screw, in some form, will probably yield the best results.

Fig. 75 represents a case of this character, where, in addition to the firmness of the tooth, the patient resided at such distance from the dentist that a visit to him could be made only at intervals of two or three weeks. It was therefore necessary to devise an appliance of such character that it could not be removed or misplaced, and with a

FIG. 75.

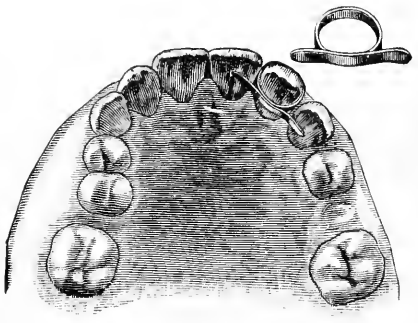


Gold Box and Screw Drawing in Cuspid.

sufficiency of power that might be regulated by the patient herself. The appliance shown in cut, consists of two platinum bands made to fit the misplaced cuspid and opposite molar respectively, and cemented to these teeth. To the palatine surface of each of these bands was soldered a gold ring, which served as point of attachment for the gold box and screw, which operated between them.

One end of the gold box was bushed and thread-cut to receive the gold screw, which at the opposite end was bent into the form of a hook to engage with the ring on the cuspid band. The other end of the box was fitted with a smooth gold wire, with a head on one end to serve as a swivel, and a hook on the other to attach to the ring on the molar band. Turning the box with a wrench drew the screw inward, and with it the cuspid tooth. Using a single molar as anchorage in the movement of a cuspid was scarcely in accord with correct practice, but in this case there was no alternative. In drawing the cuspid to place the molar was also moved somewhat inward and forward, but it soon resumed its former position after being relieved from duty. The corrected tooth was retained in place by having cemented to it the small band and bar appliance shown in position and separate in Fig. 76.

Fig. 76.

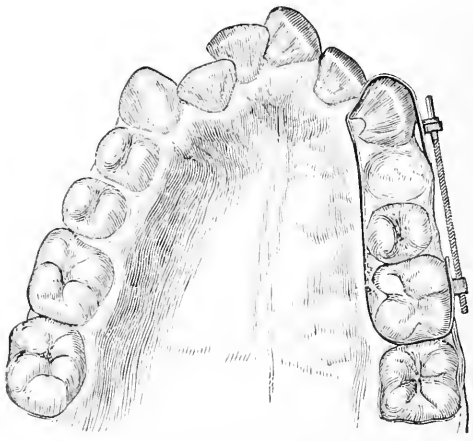


Completed Case with Retaining Appliance.

The tooth in the preceding case was retained in the same manner. Six months sufficed for each tooth to grow firm in place. Quite frequently a cuspid tooth is located so far anteriorly to its proper place that the principal movement required of it is in a backward direction. To effect this movement Dr. Farrar makes use of his device, as illustrated in

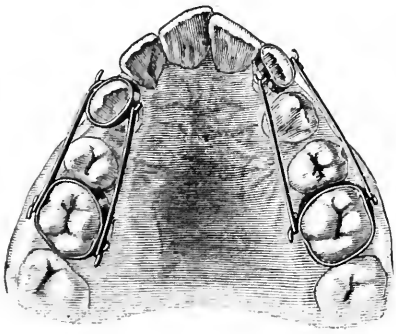
Fig. 77. It consists of a narrow ribbon of gold, long enough to enclose the cuspid tooth and some tooth back of the space it is to occupy. The ends of this ribbon nearly meet on the buccal side of the teeth, and after being reenforced with studs of heavy gold, the anterior one being simply drilled and the posterior one drilled and threaded, they are connected by means of a gold screw. The turning of the screw brings the ribbon ends nearer together, and causes corresponding traction on the misplaced tooth. The ribbon, at suitable places, has ears or tips attached to it, intended to rest upon the masticating or inclined surfaces of the enclosed teeth and prevent the band from slipping up and irritating the gum. Dr. Patrick's appliance, as shown in Fig. 22, is also well adapted to produce backward movement of a cuspid or other tooth.

Fig. 77.



Farrar's Traction Apparatus.

Fig. 78.



Author's Appliance for Retraction.

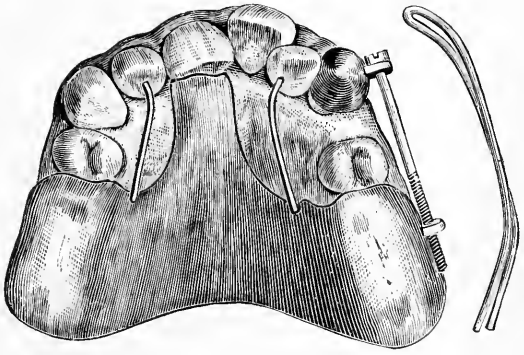
Prof. Angle accomplishes the same result by means of bands, tubes, traction screw and nut, as described and illustrated on page 96.

The author's device for the backward movement of teeth is shown in Fig. 78. It does not involve the making or use of a

plate, screws or nuts, and is very simple in design and construction. A platinum band, with short gold wires soldered to the buccal and lingual surfaces, is cemented to the tooth to be moved, while a similar one is attached to a molar or other anchor tooth. The wires on the anterior band are bent forward, and those on the posterior one are curved backward. Two rubber rings, caught over the gold hooks, connect the two bands and yield the tractile power required. These rubber rings can be removed and replaced for cleansing the teeth, or can be renewed at will by the patient. Two rings can be attached to each pair of hooks, if greater power be required, or the same object can be attained by cutting wider rings from thicker tubing.

Prof. E. T. Darby's plan for producing the same movement is by the use of a rubber plate, a gold encasement for the cuspid, and a gold screw for connecting the two and producing the required tension. Fig. 79 is drawn from one of his models, and represents the fixture in position. The case was that of a young lady, fourteen years of age, who applied for the correction of irregularity of the anterior teeth. As will be noticed in the illustration, both laterals and the right central were inside of the proper line of the arch, while the left central was outside of it. Space was needed to bring these teeth into position, and to obtain it the left cuspid had to be moved backward in the arch. Opportunity for so doing was afforded by the absence of the first bicuspid.

Fig. 79.

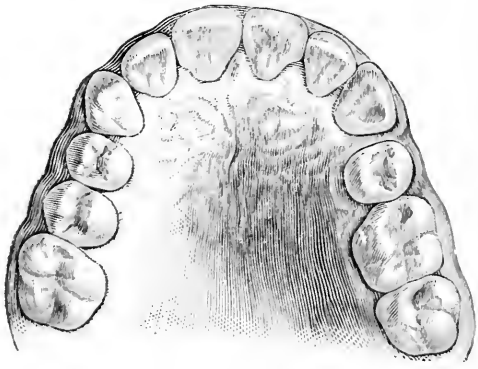


Darby's Appliance for Retraction.

To move the cuspid backward, and to assist in accomplishing other movements, a rubber plate covering the arch and capping the molar teeth was constructed, and into it on the buccal surface was inserted a gold stud or ear, drilled and tapped. A gold helmet, to cover the entire crown of the cuspid was then constructed, with a projection on the labial surface drilled for the passage of the traction screw. After this helmet was cemented in place with phosphate of zinc, and the plate inserted, the two were connected by means of a long gold screw. Twice each day this screw was turned, until the cuspid was brought almost in contact with the second bicuspid.

While this movement was progressing, other objects were being accomplished. The rubber plate when first inserted, had a piano wire spring attached to its palatine surface, to force forward the right central. This accomplished, the spring was removed and rubber added to the plate, to keep this tooth in its new position. Two new piano wire springs were next inserted, to spread apart and press forward the laterals, as shown in cut. They were brought into position by the time the cuspid had been drawn sufficiently backward.

FIG. 80.



Corrected Case.

The helmet and screw were now removed and a piece of piano wire, doubled and bent to proper shape, was inserted in the hole of the gold stud in the rubber plate, in such a way that the folded end would rest upon the outstanding central and force it into line.

The case as corrected is shown in Fig. 80. The entire

work of correction, with its varied movements occupied but five months time, and was accomplished by the use of a single plate with its different attachments. To retain the teeth in position, a rubber plate was worn, covering the arch and having a gold T inserted to pass between the centrals.

When a superior cuspid erupts inside of the arch, the difficulties attending its being brought into position are far greater than when it erupts externally. This is partly due to the fact that the space between it and the opposite side of the arch is sometimes too limited to admit of the use of some of our best power-producing appliances, and partly also to the amount of alveolar process that will have to be resorbed before the tooth can assume its proper position.

The power to be applied to an in-lying cuspid to force it outward must necessarily be very great to carry with it any prospect of success. A solid Coffin plate with a very stiff piano wire imbedded in it will yield the greatest amount of spring power, and where this proves insufficient, we must needs resort to the jack-screw in some of its forms. The ordinary jack-screw, applied between Magill bands, somewhat after the manner illustrated in Fig. 62, has, in the author's hands, accomplished the best results in such cases.

CHAPTER V.

MISPLACED BICUSPIDS.

The bicuspid teeth, both superior and inferior, are often found located outside or inside of the normal arch line, but their mal-position is not of as frequent occurrence as that of the anterior teeth.

Their position out of line, as in the case of most forms of individual irregularity, is due to lack of space, or the crowding of other teeth. Sometimes, through tardy eruption, their space in the arch has been encroached upon by the pressure of the erupting cuspids in front, as well as the forward-moving tendency of the molars. In such cases, one or both of the bicuspids are compelled to assume a position outside or inside of the arch, the latter being the one they most commonly take.

Again, their predecessors, the deciduous molars, frequently have their crowns destroyed by caries long before the time for their natural removal, while their roots remain. Inducement is thus offered to the adjoining teeth to occupy part of the space, and the bicuspids are forced to erupt in an abnormal position.

In other cases, they may have taken their places in line, or nearly so, and are subsequently forced out of place by the effort of the cuspids to occupy their places in the arch. The ease with which they may be forced out of position is readily understood when we consider that their roots are conical and rather short, and that they are placed between teeth that are firmly set and have either a single long root firmly implanted, like the cuspids, or several roots, like the molars. Their dis-

tinctly convex approximal surfaces also greatly favor their displacement.

The second bicuspid is more frequently found out of line than the first, probably because of its later eruption.

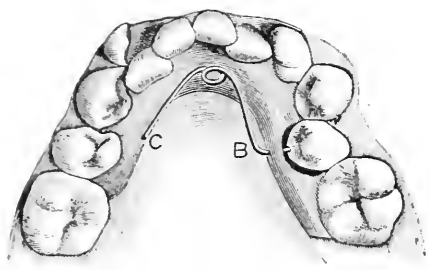
The lack of alignment of one or both bicuspids is sometimes associated with a greater or less degree of torsion; but this is not of common occurrence, and when met with is either corrected in the act of bringing the tooth into line, or will have to be remedied by a separate operation afterward.

The greater or less difficulty of bringing into line one or more bicuspids situated inside of the arch, will usually be entirely dependent upon the amount of space existing for their accommodation. If much of their space in the arch has been pre-occupied by adjacent teeth, these will first have to be pressed apart to afford accommodation. Should full or nearly full space exist for them in the arch, they may usually be forced into line by the elasticity of a vulcanite plate, or of metal in some form of spring. Where it is designed that the moving tooth shall make room for itself as it advances, the greater power of the jack-screw will be required.

A simple method of moving a bicuspid, either upper or lower, outward into line, is to obtain a plaster model of the jaw. The plaster tooth representing the one to be moved, should then be cut away on its palatine or lingual surface, until this portion of it is in line with the same surfaces of the adjoining teeth. A vulcanite plate made upon this model, with a piece of piano wire imbedded in its central portion, if it be for the lower jaw, will, by its elasticity, soon bring the tooth into position. Or, we may make the plate upon the unaltered model, and then insert a wooden peg in a hole drilled in the plate opposite the tooth to be operated upon. Or, instead of the wooden peg, a metal screw may be inserted so as to act upon the tooth. By setting the screw well into the rubber plate, it may be elongated by turning from time to time until the object is attained.

Dr. Talbot has devised an excellent method of forcing one or more bicuspids into line by means of a coiled spring of piano wire, in connection with a rubber plate to hold it in position and properly direct its action. Fig. 81 represents the appliance in position. Dr. Talbot says: *"A thin, narrow, close-fitting vulcanite plate was made, and a hole drilled through the middle of it, opposite the centre of the tooth to be moved. In the other side, another hole was drilled, but not quite through the plate. A suitable spring, Fig. 82, was then made of piano wire, having a single coil A, and the ends of its arms bent at about a right angle. One of these ends, C, was cut short to enter the corresponding hole in the plate, and the other end, B, left long enough to go through the plate and impinge on the lingual surface of the bicuspid, leaving a full eighth of an inch between that arm of the spring and the plate, as is clearly shown by Fig. 81, where the spring is in position to act upon the tooth to be moved. Both the spring and the plate may be removed instantly, either for cleansing purposes or to increase the power of the spring by spreading its arms, or to open the coil so that the tooth may be held steady at the point to which it may have been moved. Fig. 83 shows a spring having two long ends, B B, which is designed for a case in which two such teeth are to be moved in opposite directions."

Fig. 81.



Talbot's Vulcanite Plate and Coiled Spring.

Fig. 82.

Coiled Spring.

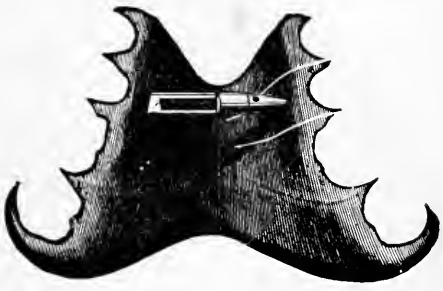
Fig. 83.

Coiled Spring.

* *Dental Cosmos*, Vol. XXVIII, pp. 286-7.

In cases where the superior power of the jack-screw is to be taken advantage of, Dr. Kingsley's method of using it in combination with a slotted vulcanite plate, is certainly one of the best.

Fig. 84.



The accompanying illustrations, Figs. 84, 85 and 86, copied from Dr. Kingsley's work,* represent some of the ways in which he accomplishes movements, slightly varying in character. Fig. 84 was used to move outward a left superior second bicuspid; Fig. 85 operated to move outward both bicuspids of the left

Fig. 85.

Fig. 86.

Kingsley's Slotted Vulcanite Plates with Jack-Screw.

side inferior, the first more than the second; while Fig. 86 moved all four of the inferior bicuspids.

A jack-screw should not rest against and operate upon naked teeth for evident reasons, but where it is desired to avoid the use of a plate, Magill bands, re-enforced, drilled and counter-sunk, may be cemented to the teeth to be moved and the jack-screw inserted between them. Prof. Angle's

* Loc. cit.

device for expanding the arch, as shown and described on page 99, may also be advantageously used for moving outward one or more of the bicuspids. It will be noticed that in the operation of this appliance any instanding teeth are moved outward into line before real expansion of the arch begins: if therefore, the moving of individual teeth is alone desired, operations can be suspended as soon as that object is accomplished.

The small size of the jack-screw in the Angle device is also an element in its favor, since it will interfere less with the movements of the tongue than the larger ones commonly used.

In addition to the power of the jack-screw, it has the further advantage of rapidity of action; so that, if its position in the mouth should somewhat inconvenience the patient, it would do so only for a very short time.

CHAPTER VI.

TORSION.

The term torsion, as applied to the teeth, signifies that condition in which a tooth is found to be turned upon its axis. Rotation refers to the act of twisting or turning a tooth so as to bring it into normal position. Torsion, therefore, describes the condition, and rotation the operation.

Torsion is usually due to some abnormal influence operative before or during eruption. Lack of space will often impel a tooth during eruption to turn in such a way as to present its smaller diameter toward the space intended for its accommodation, in order to occupy that space at all. A root, or even a portion of one, will also often cause a tooth to partly turn in its socket while seeking its position in the arch. Torsion of the superior central incisors, so often met with, is doubtless due in the majority of cases to undue thickness of the median alveolar septum. The condition is also produced after eruption by the crowding of adjoining teeth, induced by some unusual pressure, such as the effort of a later erupting tooth to occupy its place in the arch.

Torsion is met with in all degrees of extent, from the slightest prominence of one corner of a tooth to a complete half-turn.

It occurs, generally, in single rooted teeth, or in those with a slightly bifurcated root; and among these, those with roots most nearly round are the ones commonly affected on account of the ease with which they can be made to turn upon their axes.

At times cases are met with in which two adjoining teeth are thus affected, usually each in like degree, this variety of the condition being known as Double Torsion.

Rotation is usually not a very difficult operation in itself, but when complicated by the crowding or disarrangement of adjoining teeth it sometimes proves quite troublesome.

Where there is sufficient space in the arch to accommodate the tooth after it has been turned, we have simply the matter of rotation to deal with; but when such is not the case, our first efforts must be directed toward providing space. This may be done, if the deficiency be slight, by pressing apart the impinging teeth by some of the means described on page 40; but where great space needs to be provided, and expansion of the arch is not indicated, it will be necessary to extract some less important tooth to afford opportunity for bringing the turned tooth into line. In the case of teeth with flat crowns, as the incisors, we may adopt either of two plans for turning the tooth, viz.: grasping the crown throughout its entire circumference and applying suitable power, or by direct pressure upon one or both of the angles that are out of line. With teeth having round crowns, such as the cuspids, we are limited to the plan of making attachment to the periphery of the crown.

At one time it was difficult if not almost impossible to grasp a tooth so securely as to have the attachment resist the strain of the applied power, but since the introduction of the Magill band this greatest of all difficulties associated with rotation has been overcome.

One of the simplest and most effectual methods of rotating a flat-crowned tooth is by the use of a rubber plate made to cover the palate and envelope the posterior teeth on either side, according to the Coffin plan. To the palatine portion of the plate a piano wire is attached in such a way as to bear upon the inner corner of the tooth to be turned, while a similar wire imbedded in the buccal portion of the plate, is arranged to press upon the corner that projects. The bending of the wires from time to time, to increase the tension, will speedily accomplish the desired result.

Where only one corner of a tooth stands out of line, the plate just described may be modified by having but a single

wire to press inward the outstanding corner, and allowing the rubber plate to rest firmly against the corner that is in line, to prevent it from turning.

Opportunity for the projecting portion of the tooth to move inward, must of course be provided by cutting away the rubber plate at this point.

Another way of rotating a tooth, is to fit a band or ferrule of gold or platinum to it, with a headed platinum tooth-pin soldered to its labial face near the angle that is out of line. A delicate vulcanite plate is then made to fit the roof of the mouth, and into it at a suitable point is screwed a threaded gold wire with a slight curve or hook on its end. After the band is cemented to the tooth, it is connected with the gold hook in the plate by means of a rubber ring. Should it be desirable to change the point of attachment on the plate, it can be done by drilling a new hole at the desired point, and screwing a hook into it. The plate can be removed for cleansing and new rubber rings applied by the patient.

To avoid the inconvenience of wearing a plate during the school-age, the author many years ago devised a small and inconspicuous appliance for rotating a single incisor. It is shown in outline in Fig. 87, and is constructed as follows:

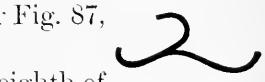


Fig. 87.

The Author's Rotating Device.

A strip of platinized gold about an eighth of an inch in width, and gauge No. 24 in thickness, is bent to conform to the outline that we wish the turned tooth and its neighbor to describe when in normal position. Each end of this strip is bent to partly encircle the disto-palatine angle of each tooth, after which another strip of gold, of similar width but thinner, is soldered to the centre of the first piece. This last piece should be long enough to extend between the teeth and embrace the protruding edge of the tooth to be turned.

By bending this arm so short that the appliance will have to be sprung into place, pressure is brought to bear upon the tooth that will cause it to rotate in its socket. The appliance

should be removed each day, the length of the arm shortened by bending, and replaced. To guard against loss or accident, a ligature of sewing silk should be tied around the neck of one of the teeth and made fast to the appliance. About ten days will usually suffice to bring the tooth into proper position.

The teeth, once in place, are readily retained by means of the small retainer shown in Fig. 88. In its construction, similar bands are made to fit both the corrected tooth and its neighbor, after which they are joined by solder at the point where they touched when in place. To add stiffness, another strip of gold should be soldered to the palatine surface of the fixture. When completed and polished, it is lined with phosphate of zinc, and placed in position upon the teeth.

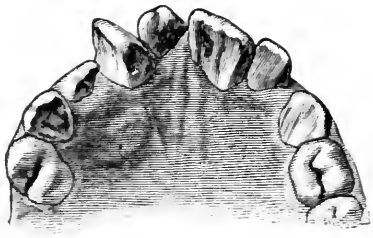
FIG. 88.

The Author's Retaining Fixture.

By the use of this retainer, which occupies but little space, the tooth is held so rigidly in its new position that it becomes firm much more rapidly than it would under other circumstances. Should the force exerted by the effort of the corrected tooth to return to its former mal-position be so great as to affect the tooth used as anchorage, this tendency may be prevented by soldering a spur of gold to the appliance at a suitable point, and allowing this to rest against some firm tooth near by.

A case in the practice of the author will illustrate a ready means of correcting an extreme case of torsion. The patient was a Japanese boy, nine years of age, whose upper denture, when he applied for treatment, presented the appearance shown in Fig. 89. The left deciduous lateral was still in place, while the right permanent lateral was just appearing through the

FIG. 89.

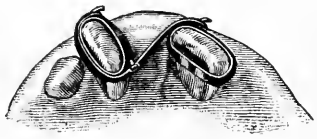


Torsion caused by Supernumerary.

gum. Both permanent centrals were fully erupted, but owing to the presence of a supernumerary tooth in the centre of the arch the right central was crowded far out of its place and turned on its axis.

After extracting the supernumerary and the deciduous lateral, platinum bands were fitted to the centrals, with a gold hook soldered to each at points that would furnish the greatest amount of tractile power. After the bands were cemented in place a rubber ring was stretched from tooth to tooth, in the manner shown in Fig. 90.

Fig. 90.



Bands and Rubber Ring for Rotation.

The malposed tooth was thus readily brought into contact with its fellow, and at the same time considerably straightened. Its further and complete rotation was then accomplished by an appliance somewhat similar to that shown in Fig. 87, after which it was retained by the retainer shown in Fig. 88. As the left central had been somewhat loosened in the act of rotating its fellow, it was found necessary, in order to secure stable anchorage, to attach a spur to the appliance and have this rest against the palatine surface of the right lateral, which was by this time almost fully erupted. In six months the teeth were firm in their new position, as shown in Fig. 91.

A simple and very effectual method of accomplishing the rotation of any tooth, without regard to the form of the crown, and one too, in which the use of a plate is dispensed with, is illustrated in Fig. 92.

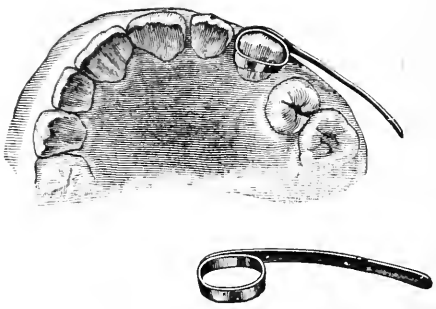
It consists of a platinum or gold band made to fit the tooth to be rotated, and having an extension bar of heavy platinized gold soldered to its labial surface. The free end of the bar is perforated by two holes for ligation to some firm tooth, usually a molar. In use, the band is cemented to the tooth

Fig. 91.

Corrected Case.

and the bar sprung down and ligated to the tooth selected for anchorage. The immense leverage of this bar will quickly compel the tooth to turn in its socket. As its force becomes spent from time to time the bar can be bent outward with pliers, without removing it from the tooth. After the tooth has been brought into proper alignment, it is most conveniently held in position by means of the retainer shown in Fig. 13. It may also be retained by a rubber plate having a gold spur to pass between the teeth and rest upon the portion of the tooth that has been moved inward.

Fig. 92.



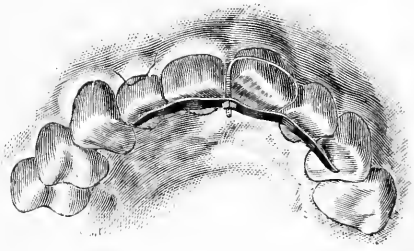
Spring Bar and Band for Rotation.

Prof. Angle has improved this appliance by making the band and bar detachable.

The band is fitted with a section of German-silver tubing soldered to its labial surface, parallel with the cutting edge of the tooth. Another band, with a hook or catch soldered to its buccal surface, is fitted to a bicuspid or molar. This latter band also has a piece of tubing, soldered horizontally to its palatine surface, through which is passed a piece of wire intended to rest against the two teeth adjacent to the one banded and thus afford greater resistance. After both of these bands are cemented to their respective teeth, a straight piece of piano wire is inserted in the tube of the tooth to be turned, and bent down and caught in the catch on the other tooth. The advantage of this modification is, that a weaker or stronger wire can be substituted at will, and the power be thus readily controlled. When the tooth is in proper line, the wire is removed and replaced by a shorter one resting upon an adjoining tooth. This acts as a retainer

by keeping the tooth in position until it has grown firm. The retaining wire is secured by means of a pin, inserted in a hole drilled through both tube and wire. Dr. Farrar's plan of producing single rotation is shown in Fig. 93.

Fig. 93.



Farrar's Appliance for Rotation.

A slip-noose, made of very thin gold or platinum about one-twelfth of an inch in width, has a threaded gold wire and nut soldered to its free end. This wire and nut engage with a strip of gold plate, bent to conform to the lingual surfaces of at least two teeth on either side of the tooth to be operated upon, as shown in the illustration. The turning of the nut draws the protruding angle of the tooth inward. The noose and bar are shown separately in Fig. 94.

Fig. 94.

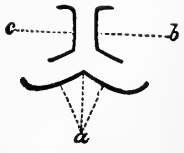
DOUBLE TORSION.

Where two adjoining teeth, as the superior centrals, are to be rotated in opposite directions, a single appliance will often accomplish both movements at the same time. The appliance devised by the author for this purpose is shown in Fig. 95, and the details of construction in Fig. 96. It is a modification of the appliance for single rotation shown on p. 147. To adapt it for duty in turning two teeth, instead of the single strip of gold passing between the teeth, two strips are bent in the form of "b" and "c." These are made long enough to be bent slightly over the labial surfaces of the teeth to be turned, extend along the mesial surface to

Fig. 95.

The Author's Device for Double Rotation.

Fig. 96.



the palatine, and then along this latter almost to the distal angle. After being properly shaped according to the model, they are clamped together and soldered along their contiguous surfaces. This part is then placed in position on the model, and the long arms bent to conform to the inner surface of the bar "a," after which it is removed, soldered to "a," and the part "b" "c" reduced in thickness by filing, so as to occupy as little space between the teeth as possible. When properly constructed the labial part of the appliance will rest against the teeth just at or slightly above the most prominent part of their convexity, while the lingual portion will be near the gum but not quite touching it, and the slightly curved ends of this part will catch just above the little prominence usually found at the disto-palatine angle near the gum.

Thus made and placed, the piece cannot become displaced by the lip or tongue, except when it has become loosened by the moving of the teeth. As will readily be seen, by its use force is brought to bear upon four points of the two teeth at one time, acting as a double lever upon each tooth.

A valuable feature of the appliance, had in view in its devising, is that it occupies but one interdental space, and thus more readily favors the turning of teeth that are more or less crowded.

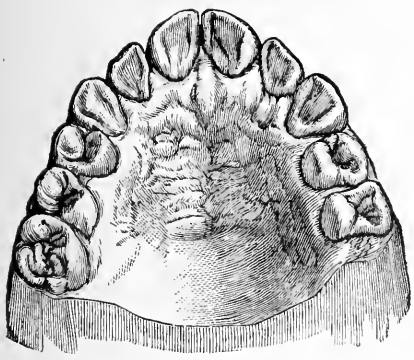
In use, the patient should be seen each day, the fixture removed and tightened by bending the long arms slightly toward the smaller ones and sprung into place.

To facilitate its introduction in the first instance, a piece of rubber should be placed between the teeth one day previous to the insertion of the appliance.

As in the case of the appliance for single rotation, a thread should be tied around one of the teeth and attached to the front bar to guard against the swallowing or loss of the piece. Fig. 97 represents a case of double torsion which was corrected in ten days time by the use of the appliance just

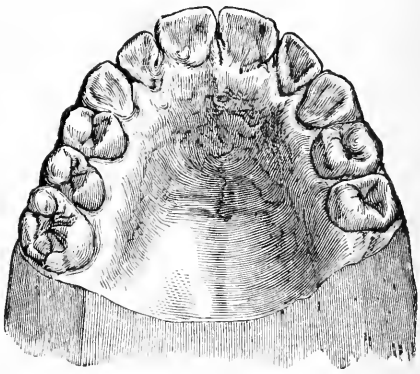
described, the patient being seen every day; while Fig. 98 shows the completed operation. After the teeth are in posi-

FIG. 97.



Double Rotation.

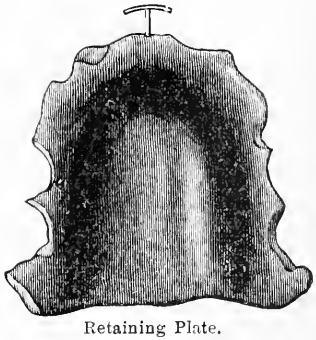
FIG. 98.



Corrected Case.

tion, they may be retained by means of the retainer shown on p. 80, Fig. 15, or a vulcanite plate with gold "T" inserted (Fig. 99), may be used instead. The former has the advantage of holding the teeth more firmly, while the latter occupies but one interdental space.

FIG. 99.



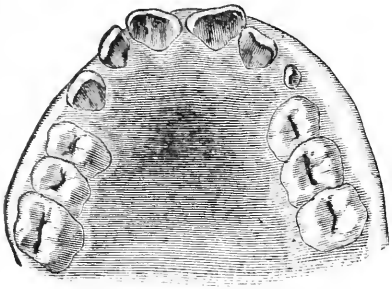
Retaining Plate.

When the distal corners of the teeth project instead of the mesial, the appliance described is rendered equally serviceable by reversing its position and placing the long arm on the labial surface. Fig. 100 represents a case of this character, while Fig. 101 shows the rubber plate with gold wire bow that was used to retain the teeth after correction.

Prof. Angle has devised a very simple and effectual method of accomplishing double rotation, where the mesial angles protrude. Upon each of the teeth to be rotated he places Magill bands with tubes soldered to their labial faces near the distal angles. One tube is set vertically and the

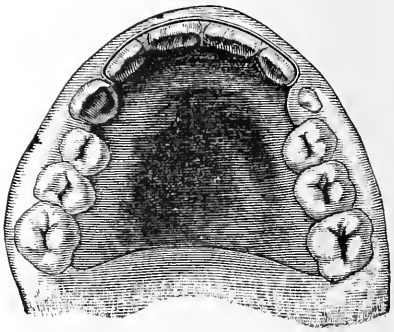
other horizontally. A short piece of piano or German silver wire, bent to a right angle at one end, is inserted into these

Fig. 100.



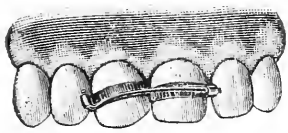
Torsion of Centrals, with Distal Angles pointing Outward.

Fig. 101.



Retaining Plate on Corrected Case.

Fig. 102.

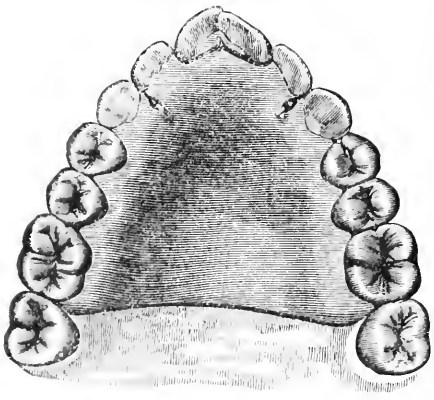


Angle's Appliance for Double Rotation.

tubes, and rotation is effected by the elasticity of the wire. The device is shown in Fig. 102.

Once in position, the teeth are retained by inserting in the tubes a suitably shaped piece of non-elastic gold wire.

Fig. 103.



Kingsley's Vulcanite Plate and Elastic Band.

Dr. Kingsley * accomplishes the same result by the use of a vulcanite plate and an elastic rubber band. Into the plate at convenient points, are inserted gold hooks and staples, and over these and around the teeth the rubber band is woven in such a way as to press outward the instanding corners of the incisors. Fig. 103 well illustrates the device.

* Loc. cit., p. 103.

CHAPTER VII.

CONTRACTION OF THE ARCH.

A contracted arch may be due to lack of development, caused by late or mal-eruption of some of the teeth; to the loss of certain of the permanent teeth soon after their eruption; or to mal-position of the teeth in the opposite jaw.

The late eruption of the superior cuspid teeth, where their spaces have been pre-occupied by teeth anterior and posterior to them, is perhaps the most frequent cause of this deformity.

In some cases, the contraction is limited to the molar and bicuspid region; in others, to the anterior alone; while in others still, the entire arch needs expansion.

The enlargement of the arch, either at certain points or in its entirety, may be accomplished by a variety of methods.

Where lateral expansion is desired, it may usually be brought about in a simple manner by the use of the Coffin split-plate, the construction and operation of which are described on p. 101.

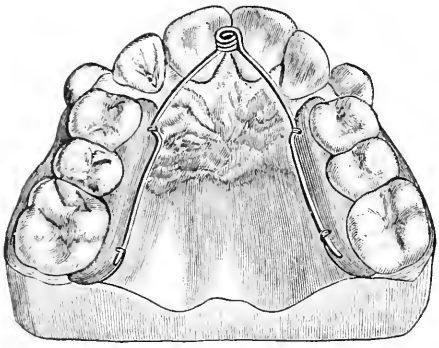
Another form of appliance, intended to accomplish the same purpose and constructed of piano wire and vulcanite, has been devised by Dr. Talbot, and is illustrated in Figs. 104 and 105.

In his description, Dr. Talbot says:* "A (vulcanite) plate is made to fit the teeth and alveolar process, and cut away so that the anterior parts extend far enough forward to enclose the teeth to be moved. A piece of (piano) wire is bent into either of the forms shown in Fig. 105, wherein "a" is the coil and fixed point, "b b" movable arms extending from "a," and "c c" movable arms extending from "b b."

* Talbot's Irregularities of the Teeth. P. 129.

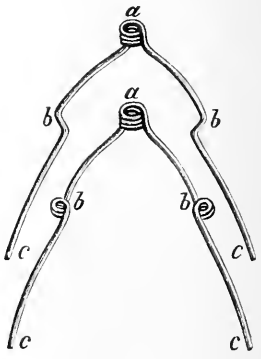
Grooves are cut into the anterior and posterior parts of the plate, to correspond with and receive the points "b b" and "c c." Holes are drilled at these points, and the wires tied to the rubber plates. In order that the anterior teeth may

Fig. 104.



Talbot's Appliance for Lateral Expansion

Fig. 105.



Talbot Springs.

be moved with the greatest force, the arms are so adjusted that the greatest pressure is exerted on the anterior parts of the plates. This appliance is readily removed for cleansing, and returned to place by the patient."

Where more force is required than can be obtained from either of the appliances just described, it can be had by the more direct power of the jack-screw, operating upon the portions of a rubber plate lying next to the teeth to be moved.

Dr. Kingsley's neat and effective appliances of this character are shown on p. 143.

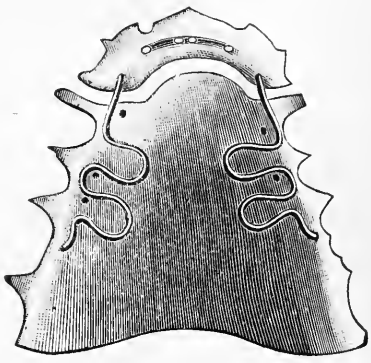
The use of the jack-screw in the lower jaw would appear to be objectionable on account of its being in the way of the tongue; but experience has proven that this objection is, in fact, a slight one.

The use of the screw hastens the operation, and thus lessens the period of inconvenience in any given case.

When expansion of the anterior portion of the arch is

desired, it may be accomplished by means of the appliance shown on p. 122, or by a modification of the Coffin split plate devised by Prof. C. L. Goddard. The latter is shown in Fig. 106.

Fig. 106.



Goddard's Split Vulcanite Plate.

As will be seen, there are two corrugated piano wires attached to the rubber plate, one on each side near the free margins, while the plate is split laterally just back of the incisor teeth. As in other split plates for anterior expansion, this plate is made in one piece and the wires arranged so that their anterior ends are imbedded in the portion to be detached, while the posterior ends are fastened to the main body of the plate. After the completion of the plate the front portion is separated by means of a jeweler's saw, and pressure is produced by stretching the wires from time to time.

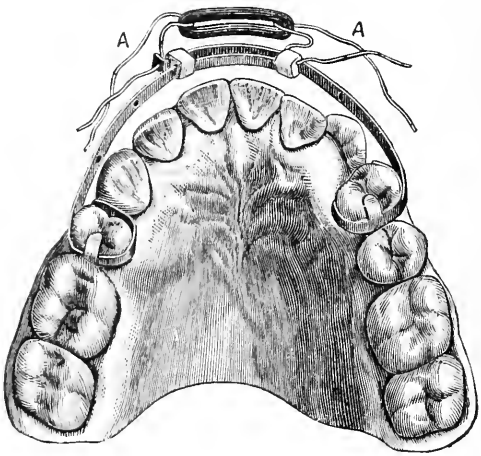
The anterior portion is kept down to its place by being ligated to the central incisors. In using this form of plate the author has found it more convenient to hold the front portion down by imbedding in the plate a gold spur, to pass between the centrals in the free space near the gum. He also prefers to secure the main portion in position by making the plate to cover and grip the bicuspids and molars, as in the Coffin method, instead of fastening it to the side teeth with ligatures. The appliance is most admirably adapted to the purpose for which it was devised.

Dr. Bonwill's appliance for producing anterior expansion of the arch possesses certain features not met with in other appliances. Fig. 107 represents the device in position, but not under tension.* "It is made of two flat bars of platinized gold, sliding over each other for at least two inches. A

* Gorgas' Harris Principles and Practice, p. 467.

loop is soldered to the end of each flat bar as guides, to hold them in position while sliding through. A rubber band is shown attached to the end of each bar at A A, which, in contracting, enlarges the circle, and consequently not only throws out the incisors, but the bicuspids and cuspids as well.

Fig. 107.



Bonwill's Appliance for Anterior Expansion.

"The attachments are made on either side to a molar or bicuspid, owing to the ease of clasping. Before the apparatus is placed permanently in position, the four incisors are ligated with a loop, using gum sandarac varnish to prevent slipping or turning on the tooth. These are now tied to the sliding bars, bringing the latter closely in contact with all the teeth intended to be moved.

"The rubber band is next tied between the two points A A, and the application is complete."

The expansion of the entire arch at one time is seldom called for, but Dr. Kingsley, in his work,* records a case in which he accomplished it by simply inserting rubber wedges between all of the teeth in the arch, replacing them with larger ones as space was gained. See Fig. 108.

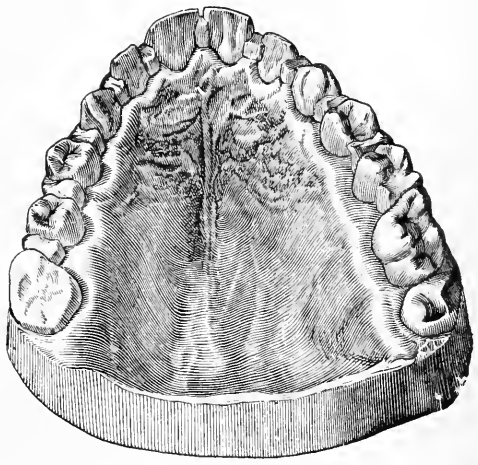
Prof. J. B. Littig has accomplished the same result by the use of wooden wedges instead of rubber.

A better plan, in the opinion of the author, where expansion of the entire arch is desired, is to accomplish it by separate operations. Lateral expansion, for instance, can

* Loc. cit., p. 129.

be accomplished first, and after the bicuspids and molars have been brought into proper position, they may be retained by means of a rubber plate covering them. This plate will not only hold them firmly, but serve as an anchorage to which other fixtures may be attached for the expansion of the anterior portion of the arch, as in the Goddard plan.

Fig. 108.



Expansion of Arch by Rubber Wedges (Kingsley).

The details of a case of general expansion of the superior arch, may be of interest to the student. The patient was a boy of about fifteen years of age. The inferior arch was of normal size, with the teeth well arranged. In the superior arch, all of the teeth except the cuspids articulated inside of the lower ones, giving the patient a pinched or contracted appearance in the region of the upper lip. The laterals were almost in contact with the first bicuspids, while the cuspids had fully erupted outside of the arch and were overlying the laterals.

Extraction was not indicated, for all of the teeth were needed to fill the arch after its expansion.

By means of a Coffin split-plate, lateral expansion was accomplished in about a month, so that the bicuspids and first molar on each side, occluded normally with those below. Next, with another Coffin solid plate encasing the teeth that had been moved, and with two piano wires attached, the laterals were pressed forward; after which, new

rubber was added to the plate to keep these teeth in position, and the wires changed to press the centrals forward into line with the laterals. After this had been accomplished there was still insufficient space for the accommodation of the cuspids, and as the incisors were already so far forward that pressure could not advantageously be brought to bear upon them from the rear, another plan for increasing the cuspid space was decided upon. Magill bands were made to fit the laterals, with a gold spur extending along the palatine surfaces of the centrals to insure uniform movement of the four incisors. Platinum bands were also attached to the first bicuspids. All of these bands we re-enforced with an additional piece of platinum soldered to the portion next to the space. Through these re-enforcements, at about the centre of the tooth, holes were drilled entirely through the bands. Piano wire was next bent into the form of small U-shaped springs with the ends at right angles, similar to Dr. Talbot's plan, but without the coil. Grasping these near the neck with a pair of narrow-beaked right-angle forceps, transversely grooved near the points to seize the wire, the springs were placed in position with their ends resting in the holes of the bands. As, from time to time, the force of these springs became spent, they were removed and their power renewed by enlarging their curves. Sufficient additional space having been gained by their use, the cuspids were forced into position by means of a Coffin plate with wires attached to the buccal surfaces, extending forward and resting upon the labial surfaces of the cuspids.

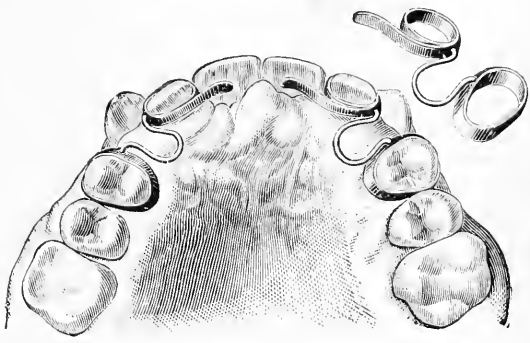
The appearance of the arch and teeth with the U-springs in position, is shown in Fig. 109. The operations were not hurried, and consumed about one year's time.

A retaining plate of vulcanite covering the roof of the mouth, with gold loops attached to overlie and retain the cuspids, is now being worn.

Another case, differing somewhat from the one just given, was that of a young girl about eleven years of age, whose

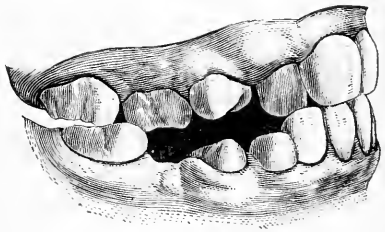
superior arch did not need lateral expansion, but required anterior enlargement to accommodate the in-coming cuspids. False occlusion of the superior incisors also needed correction. Fig. 110 represents the case as it presented. The superior centrals met the lower ones edge to edge, while the superior laterals passed inside of the lower ones. There was very little room between the superior laterals and first bicuspids to accommodate the cuspids, which, slow of eruption, were just beginning to make their appearance.

Fig. 109.



Increasing Space by Curved Spring and Bands.

Fig. 110.



Case Requiring Anterior Expansion.

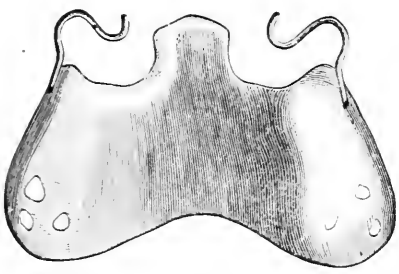
The treatment required was the moving of the laterals and centrals so as to overbite the lower ones, and the moving backward of the bicuspids on each side, to afford space for the cuspids. The laterals were first moved forward in line with the centrals, by means of the plate shown in Fig. 111. This accomplished, the anterior portion of the arch was expanded by a Goddard split plate.

A plain rubber plate, covering the arch and touching each tooth was next made, and into it were secured on either side pieces of piano wire bent to a right angle at their free ends, the bent portions being arranged to rest upon and press

against the mesial surfaces of the first bicuspids to force them backward. The plate having been trimmed to admit of the backward movement of the bicuspids, full space for the cuspids was soon gained.

The slow eruption of the cuspids required a retaining plate to be made, armed with gold spurs at suitable points, to keep the regulated teeth in their new positions and await the full eruption of the cuspids. This is now being worn.

Fig. 111.



Coffin Plate for pressing Laterals forward.

In the course of six months or less the cuspids will probably have assumed, unaided, their proper places in the arch, and by their key-like position will preserve the present arrangement without the further aid of any retentive appliance.

The case had previously been in the hands of two dentists, who began operations for correction, and it therefore became necessary for the author to carry it forward to completion.

Had he been consulted in the beginning, he would have advised non-interference until two years later, when the cuspids would have been partially erupted, and more nearly ready to assume their places in the arch, as soon as room was provided.

In this way the wearing of a retaining plate, to await the full eruption of the cuspids, would have been avoided and the case simplified.

CHAPTER VIII.

PROTRUSION OF THE UPPER JAW.

The causes tending to produce this condition, have been briefly considered on p. 22.

There are two varieties of this deformity :—

1st. Where the lower teeth are in line forming the normal curve, while the upper ones pass over and beyond them in such a way as not only to interfere with enunciation, but also to render them almost unserviceable in mastication. This form is usually attributable to inheritance; to the abnormal size of the teeth in the superior arch; or to the mechanical influence of pressure on the part of the posterior teeth. It is the one most easily corrected, on account of the operations being confined to a single arch.

2nd. Where the lower incisors are flattened in outline or introverted, and the superior ones extend so far forward as to leave a large space between the two when the jaws are closed. In this case, the superior protrusion appears to be greater than it really is, on account of the superior and inferior teeth inclining in different directions. Where there is introversion of the inferior incisors we generally find their cutting edges on a higher plane than that of the neighboring teeth. This does not signify that these teeth are elongated, but simply that their position causes them to reach a higher level.

This condition is, in most cases, due to the habit of thumb-sucking, the thumb pressing the lower ones in and the upper ones out at the same time.

The relative height of the cutting edges of the lower incisors causes them, in most cases, either to occlude with the base of the crowns of the superior incisors, or to come in contact with the soft tissues back of them. This condition

seriously complicates the matter of correction, for it interposes an obstacle to the inward movement of the superior teeth, and the outward movement of the inferior ones.

Where the protrusion is slight and the teeth are in contact, space for their inward movement may sometimes be obtained by dressing off any discoloration or superficial decay from the approximal surfaces of the six anterior teeth with sand-paper discs or emery-cloth strips, followed by thorough polishing.

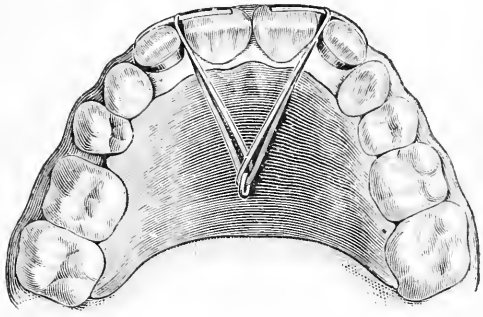
By this means the author has, in a few instances, materially improved the patient's expression, without loss of teeth or injury to tooth-substance. The space once gained, the teeth can easily be brought inward by the use of a Coffin plate, cut away posteriorly to the incisors, and having gold hooks attached to the anterior portions of the plate on the buccal surface. A rubber band caught over the hook on one side, carried along the labial surfaces of the anterior teeth, and attached to the hook on the opposite side, will generally provide the required tension. Small double hooks, made from half-round gold wire and hung over the cutting edges of the centrals, will, by their second curves, support the rubber band in proper place and keep it from resting upon and irritating the soft tissues. Other simple means for effecting the same result, will readily suggest themselves to the operator. Where the protrusion is of greater extent and the teeth are in contact, it will be necessary in most cases to sacrifice a bicuspid or molar on one or both sides of the mouth to obtain sufficient space to enable the anterior teeth to be moved backward into line.

After the extraction of the tooth or teeth it is well to draw backward, by easy stages, the teeth on either side anterior to the space, to and including the cuspids. The subsequent drawing in of the four incisors will then be a comparatively easy matter. In many cases, if the posterior teeth were used as anchorages for the inward movement of six or ten anterior teeth, they would be more likely to move forward

than to cause the anterior ones to be forced backward, on account of the disparity of resistance.

A number of methods for moving backward the cuspid and bicuspid teeth are described on pp. 136 and 137. A simple plan for drawing in the four superior incisors, is shown in Fig. 112. Platinum bands are fitted to the laterals, and to their labial portions are soldered extensions of gold, to cover and rest upon the labial surfaces of the adjoining centrals. A plain rubber plate is also made to cover the palatine arch, with a gold hook inserted in its centre. The bands being cemented in place, rubber rings are slipped under the extensions and carried to a point between the centrals and laterals, where they are drawn in and over the gold hook in the plate. By their contraction, all four of the incisors are drawn inward while but two of them are banded.

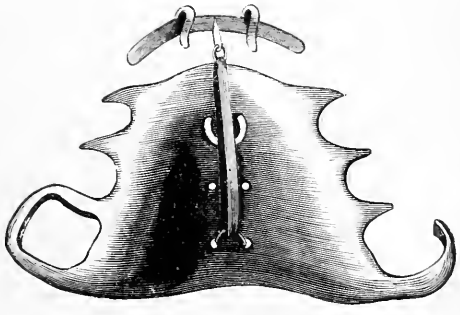
FIG. 112.



Author's Device for Retracting the Superior Incisors.

A plan differing somewhat from the one just described, is that of Dr. Kingsley's, illustrated in Fig. 113. The band overlying the incisors is of gold, and has hooks soldered to the upper edge, to prevent its slipping up to the gum. It is also fitted with a thin strip of gold to pass

FIG. 113.

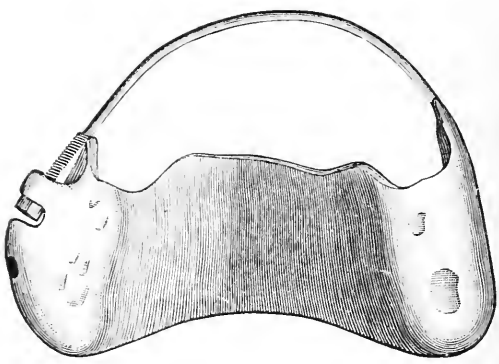


Kingsley's Gold Bar and Vulcanite Plate for Retraction.

between the centrals, while its free end is connected with the centre of a vulcanite plate by means of a ring cut from rubber tubing. This rubber ring is made fast to the plate either by means of a ligature or by slipping it into a horse-shoe slot cut in the plate for the purpose.

In many cases the elasticity of rubber is not sufficient to move the four teeth as rapidly as desired. In such an event, the direct and forcible action of the screw may be brought into play by means of the device of Dr. S. G. Perry, shown in Figure 114. It is a vulcanite plate covering the arch and encasing the molars, to which is attached a half-round gold wire bent to a curve and long enough to extend along the outer surfaces of the teeth from molar to molar. One end of this curved wire is permanently attached to the vulcanite plate, while the other terminates in a threaded wire, which engages with a gold nut playing in a slotted recess of the plate on the opposite side. Turning the nut shortens the bar and draws the teeth inward.

FIG 114.



Perry's Appliance for Retraction.

When still greater power is demanded, as in cases where it is desired to draw the six anterior teeth inward by one operation, or where the incisors do not yield readily to any power that can be applied within the mouth, anchorage for resistance must be obtained outside. Dr. Kingsley, we believe, was the first to suggest and utilize the back of the head as an anchorage for appliances intended to produce movements of the teeth. Illustrations of a fixture of this character will be found in his work, pp. 133 and 134.

Dr. Farrar also devised an apparatus for the same purpose, but it is somewhat complicated in its construction and manner of adjustment.

One of the simplest devices of this character, is that of Prof. C. L. Goddard.* In describing the construction and use of his appliance, he says: "On a cast of the superior incisors a small sheet of wax was placed, covering the labial surfaces, cutting edges and part of the lingual surfaces. In the anterior surface of this wax plate, a steel wire was imbedded, curved to conform to the arch, and extending laterally about one inch and a half on each side. The ends of this wire were bent in the form of hooks. The wax plate and wire were then imbedded in a flask by bending the ends of the wire sufficiently to allow them accommodation inside of the flask. By the methods usually employed in vulcanite work, a plate was thus made of black rubber with the wire attached, as shown in Fig. 115.

FIG. 115.

Goddard's Steel and Vulcanite Appliance for Retraction.

"When placed on the patient's teeth, the ends of the wires projected from the corners of the mouth on each side far enough to permit elastic bands to connect them with a cloth cap on the patient's head without touching the cheeks.

"The cap was so shaped that the elastic could be attached to it in two places on each side, one above and one below the ear, by means of dress hooks sewed to the cap at these points. Round silk covered elastic cord was used, and the direction of the force could be varied by using a greater number of stands above or below the ear, according to the requirements of the case. The amount of force was easily

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*Annual of the Universal Medical Sciences, for 1888, Vol. III., pp. 547–551. F. A. Davis, Philadelphia, publisher.

varied by shortening or lengthening these cords. Fig. 116 shows the appliance in position.

"This appliance was worn at night only, and the teeth were soon moved back to the desired position. The inferior incisors striking the bases of the superior ones, as they were moved back, were moved with them. After the teeth were in proper position, the tension of the elastic cord was slightly lessened, and the appliance worn at night for a few months as a retaining appliance until the teeth became firm.

Fig. 116.

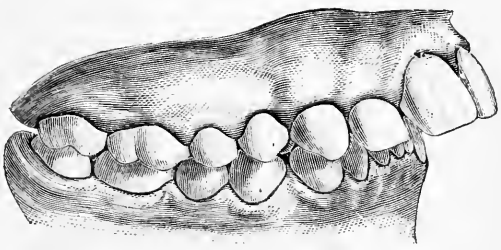
Goddard Appliance in Position.

"The greatest usefulness of this appliance is in cases where there are no teeth in the mouth sufficiently firm for the anchorage of an appliance of ordinary form, or where the teeth, if firm enough, are of such shape that it is practically impossible to fasten appliances to them."

The author recently corrected the worst case of superior protrusion he ever met with, using an appliance differing from Prof. Goddard's only in certain minor particulars.

The patient was a boy, sixteen years of age, whose superior teeth projected beyond the lower ones at least three-quarters of an inch. The inferior incisors were relatively long, and their cutting edges, in occlusion, imbedded themselves in the soft tissues of the palate quite a distance inside of the superior teeth. Both arches were wide and well-formed, with the exception of the superior protrusion, and all the teeth were in contact. Fig. 117 shows the relation between the upper and lower teeth at the time of presentation for treatment. All of the teeth being equally good, the first bicuspids were removed to create space. An appliance of vulcanite and wire, similar to Prof. Goddard's, was then made; the wire, after it was properly fashioned, being nickel-plated before vulcanization. The scull-cap, instead of cloth, was made in skeleton form, of inch-wide black silk ribbon, each strip being double and lightly stuffed with cotton to make it more comfortable to the patient. The elastics used were the ordinary flat and wide rubber bands, cut and perforated near the ends to engage with the hooks on the cap. The teeth being large, strong and firmly set, especially the cuspids, moved slowly; but in five months' time, by the use of the above appliance alone, the teeth were moved back into proper position, the cuspids coming into close contact with the second bicuspids. The cutting edges of the lower incisors were ground off somewhat, to enable the superior ones to be moved inward.

FIG. 117.

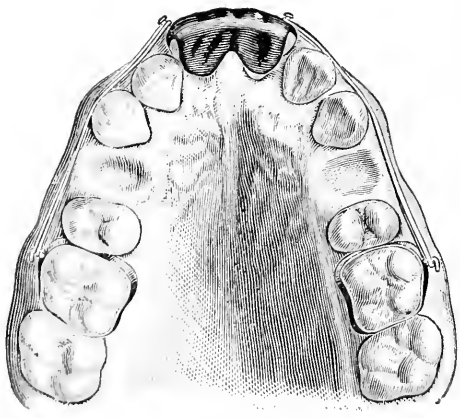


Superior Protrusion caused by Thumb-Sucking.

The boy being in attendance upon school at the time of the operation, and not wishing to subject himself to the rid-

icule that the wearing of such a conspicuous appliance would surely bring upon him on the part of his schoolmates, an accessory appliance was devised for him to wear during school hours. It consisted of a thin silver saddle covering the protruding centrals, to which, on the labial surface near the terminations, were soldered two platinum headed pins. The first molars were fitted with platinum bands, to which platinum hooks were also attached on the buccal surface. The bands were cemented to their respective teeth, while the saddle was removable. This appliance, in position, is shown in Fig. 118.

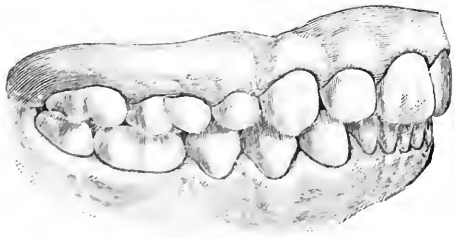
Fig. 118.



Day Retaining Appliance.

In use, the saddle was placed in position and the pins upon it and the molar bands connected by means of thin rings cut from French rubber tubing of small diameter. This fixture was simply intended to retain, during the day, the progress made by the more powerful appliance at night. It was put on in the morning before starting for school, and after school hours was replaced by the pressure appliance, which was worn until morning.

Fig. 119.



Corrected Case.

Both appliances were removable for cleansing, and were readjusted and operated by the patient himself. They gave

him no pain or inconvenience to speak of, and required very little oversight on the part of the operator.

The day appliance is now being worn as a retainer. For the first three months, it will be worn both day and night, and for the succeeding three months at night only.

Fig. 119 shows the relation of the teeth after the operation was completed.

CHAPTER IX.

PROTRUSION OF THE LOWER JAW, OR PROGNATHISM.

This condition, one of the most unsightly of dental deformities, giving to the individual a rather inhuman expression and interfering greatly with speech and mastication, is quite frequently met with. The causes probably responsible for its inducement are given on pp. 23 and 24.

When the deformity is slight it may be corrected, or at least modified, by pressing the lower incisors inward and the upper ones outward; but where the case is pronounced, there seems to be no remedy for it but the retraction of the entire inferior maxilla. This may be best accomplished by using some form of scull cap, and connecting it with a padded chin piece by means of strong rubber bands. The persistent contraction of the rubber will, in a greater or less time, dependent largely upon the extent of the deformity and the age of the patient, bring about the desired change.

In the accomplishment of this retraction, it was formerly supposed to be brought about by a change effected at the angle of the jaw; but the more plausible hypothesis, is the one first advanced by Dr. Geo. S. Allen, namely: That the pressure applied to the mental region, causes resorption of the posterior wall of the glenoid cavity, thus permitting the condyles to recede and articulate somewhat posteriorly to their former position. This theory as to the physiological change brought about, is supported by the fact that an alteration of form in the glenoid cavity is more readily accomplished by resorption, than a bending of the maxilla at one of its strongest points.

An interesting case of retraction of the lower jaw, was brought before the Odontological Society of New York, in 1878, by Dr. Allen. I quote important points from his

description: "As will be seen from the photograph (Fig. 120), taken at the time she was wearing this apparatus, it consists of two parts. For the lower part, I made a brass plate to fit the chin, having arms with hooked ends reaching to a point just below the point of the chin. These arms were arranged in such a way, that the distance between them could be altered at will, by simply pressing them apart or together. The upper part consisted of a simple network,

FIG. 120.

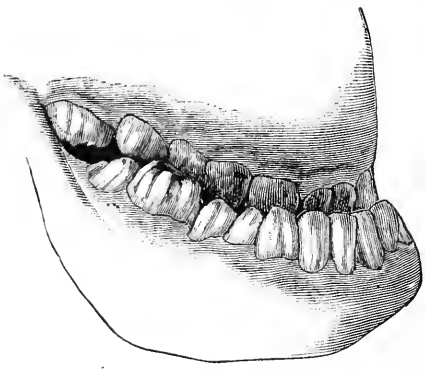
Allen's Device for Retraction of Lower Jaw.

going over the head and having two hooks on each side, one hook being above and the other below the ear. When this apparatus was completed and in use, there were four ligatures of ordinary elastic rubber, pulling in such a way as to force the lower jaw almost directly backward. The work proceeded very rapidly, so that at the end of two months, the irregularity was almost entirely cured. I see no reason why, in all such cases, either this or similar methods of pro-

cedure should not be adopted. I should certainly, if any similar cases presented hereafter, even at twelve or thirteen years of age, before attempting any other procedure, try this first and thoroughly."

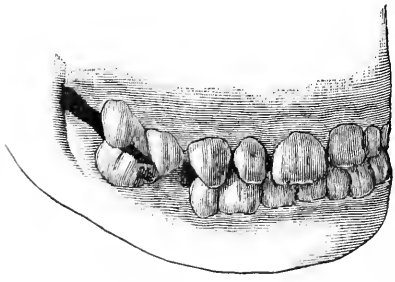
The Drs. Winner, of Wilmington, Del., have furnished the writer with models and description of a case somewhat similar to the foregoing (Figs. 121 and 122). In their case, the patient was a boy fourteen years of age, tall, slender, possessing good general health, but only fair physical strength. The models show that there was a bicuspid lacking on each side above, while below there still remained two temporary molars. He stated that he had never had any teeth extracted by a dentist, so it is probable that the two bicuspids were never erupted. The superior centrals were considerably worn away on their cutting edges and labial surfaces by attrition with the lower ones. After extracting the deciduous molars below, a plate was made covering the upper posterior teeth, and so arranged that in addition to furnishing a masticating surface while the teeth were apart, it also acted as an inclined plane in helping the lower jaw

FIG. 121.



Prognathism.

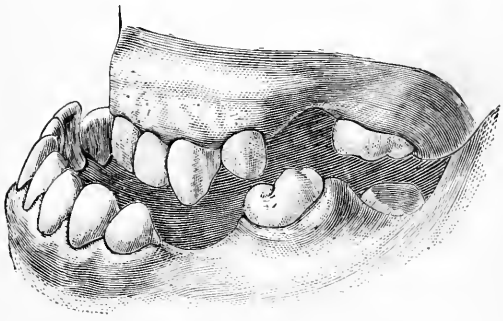
FIG. 122.



Case Corrected.

to move backward. From first to last he wore an occipito-mental sling, as illustrated in Garretson's Oral Surgery, increasing the tension from slight at first to as tight as could be worn without too great discomfort. At the end of nine weeks the articulation was normal, but the sling was worn for several weeks longer, without increased tension, to retain the satisfactory result secured.

FIG. 123.



Excessive Prognathism.

Fig. 123 illustrates the most pronounced case of this class of deformity the writer has ever met with. The patient was a man of about forty years of age, and was brought by a neighboring dentist for consultation as to whether anything could be done to remedy the defect. The lower jaw was very large in all its aspects, while the upper was correspondingly small. Although the lower incisors inclined decidedly inward, the distance from the cutting edge of the lower incisors to the cutting edge of the upper in a horizontal line, was a little over half an inch. From the upper jaw there were missing the right lateral, second bicuspid and first molar; while on the left side, the second bicuspid and two molars were absent. In the lower jaw, the patient had lost two molars and a bicuspid on the left side, and the first molar on the right. All the teeth of the upper jaw passed inside the lower, except the first bicuspids, whose external cusps articulated slightly with the anterior lingual cusps of the opposite molars below.

The advanced age of the patient, conjoined with the conditions just described, placed his case beyond surgical

remedy and he was so informed. A plate covering and masking the natural teeth above with artificial teeth mounted outside to articulate with the lower ones was suggested, but the idea did not please him, and he concluded to pass the remaining portion of his life as he did the first, so far as his dental apparatus was concerned.

CHAPTER X.

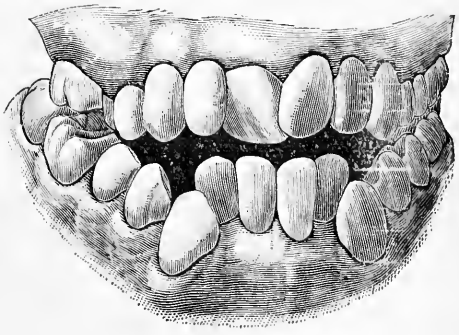
MISCELLANEOUS.

LACK OF ANTERIOR OCCLUSION.

In certain rare instances, cases are met with in which the anterior teeth do not come in contact upon closure of the jaws. The bicuspids and molars of both jaws may articulate properly, but in the front part of the mouth upon occlusion, there exists a space more or less great between the cutting edges of the incisors. The space is greatest at the median line and gradually diminishes toward the cuspids. The condition not only gives a lisp to the speech of the individual but renders these teeth entirely useless for purposes of mastication.

At first glance the incisors have the appearance of being too short in their crowns, but an examination will show that they are of normal size and length and that the process and possibly the maxilla itself is responsible for the shortened appearance.

FIG. 124.



Lack of Anterior Occlusion.

In most cases it will be found that both arches are normal in form and size, that there is no protrusion or introversion either above or below, and that the superior teeth alone are at fault. Fig. 124 represents a

typical case of this character, the model being from the collection of Dr. H. A. Baker.

Fortunately, the condition is seldom met with, for it is the one of all others that is least amenable to successful treatment.

The cause of the deformity has been variously attributed to thumb-sucking, to sleeping with the mouth open and to derangement of the articulation caused by ill-advised extraction of some of the posterior teeth: but while all of these are doubtless responsible for the condition in many instances, it is probably more frequently caused either by the lack of alveolar development in the incisor region, or an unaccountable variation in the plane of the alveolar border of the maxilla. The author has met with no cases of this condition that bore evidence of hereditary transmission, and therefore believes it to be due to a peculiarity in the development of the maxilla, originating with and confined to the individual himself.

In the line of treatment, so far as the author is aware, but two plans have been adopted. One, where the deformity is slight, consists in grinding off the cusps and antagonizing points of some or all of the posterior teeth in order to shorten the bite and bring the anterior ones more nearly together. Much of this cannot be done without denuding the teeth of their enamel at certain points and exposing the sensitive dentine, but done in moderation it will often aid quite a little in lessening the deformity.

The other plan, for aggravated cases, is to produce pressure upon the anterior portion of the lower jaw by means of a skeleton cap, chin-piece and rubber bands, very similar to the appliance used in retraction of the lower jaw, only that in the present case the power should be applied in an almost vertical direction. With such an apparatus, worn continuously for a few months, the condyles of the lower jaw will be tipped somewhat out of their cavities and the latter be partially filled up with new ossific material.

REDUCTION OF ELONGATION OF THE ANTERIOR TEETH.

Normally, each tooth will advance in the course of its eruption until the whole of its crown projects beyond the free margin of the gum, and its cutting edge or masticating surface is in proper relation with the same surfaces of the adjoining teeth. Full eruption may be delayed or entirely prevented by accidental circumstances, but extra elongation will not occur of its own accord. When it does occur, it is the result of an abnormal condition of the pericementum, most generally due to irritation in some form, or it is caused by lack of occlusion with teeth in the opposite jaw. In the latter case, it is but the manifestation of nature's attempt to rid the system of a useless organ.

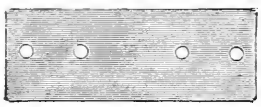
Elongation of one or more of the superior incisor teeth sometimes occurs in connection with regulating, and is due either to the irritation of the soft tissues surrounding the tooth caused by the impingement of the regulating appliance upon them, or to the unfortunate application of power in such manner as to favor the lifting of the tooth from its socket.

When such elongation is noticed, it becomes necessary to remove the cause and give rest to the affected parts. The elongation being due in the first instance to the temporary thickening of the peridental membrane through irritation, a period of rest will usually result in the subsidence of the trouble and the return of the tooth to its former position. Where the elongation is the result of misdirection of power the operation will have to be suspended for a time, to be followed by the use of more correct appliances. Should the condition, however, be allowed to continue for any length of time, as through non-appearance of the patient, some pressure may have to be applied to force the tooth back into its socket. This may be accomplished in a very simple manner by adopting the plan suggested by Dr. Wilhelm Herbst for retaining a replanted tooth.

It consists in cutting a short and narrow strip from a

piece of rubber dam and perforating it in such manner that when in position, the crowns of two teeth on either side of the one affected will protrude through the openings, while the elongated tooth will be partly covered and pressed upon by the intervening portion of the rubber. Figs. 125 and 126 represent the strip of rubber separately and in position. Another way of producing tension upon the elongated tooth, is by means of a rubber plate with a strip of gold so attached as to rest and press upon the cutting edge of the tooth.

FIG. 125.



Herbst Method of Retention.

FIG. 126.

Rubber Strip Applied.

Neither of the appliances just mentioned need be worn long, for the continuous pressure will quickly cause retrogression of the tooth.

ASSISTED ERUPTION OF THE ANTERIOR TEETH.

Incisor teeth that have not erupted to their full extent and have been prevented from doing so by too close proximity of adjoining teeth or other cause, may often be assisted in assuming their proper alignment. Where space exists, teeth will naturally accomplish their full eruption unaided, as previously stated. When they do not, and there is no visible cause for their not doing so, we may safely infer that some hindrance exists in the tissues beneath the gum. It may only be an unexplainable suspension of the act of eruption, or it may be, and often is, a curvature or enlargement of the root that prevents the further progress of the tooth. Which of the two it is, can usually only be decided after measures of assistance have been tried.

If the delayed eruption has been due simply to a suspension of the act of eruption, the simplest and most effective remedy will be found in tying a silk ligature around the neck of the tooth and pressing it well under the free margin

of the gum, or in placing a ring cut from rubber tubing in the same position. Either one will cause irritation of the pericementum, which by consequent enlargement will tend to force the tooth out of its socket. To prevent undue elongation the case will have to be carefully watched, day by day, and the irritating ligature removed as soon as the tooth has been sufficiently elongated. Should this be neglected, the tooth might be entirely expelled and lost.

Should these simple means fail to move the tooth from its abnormal position, osseous abnormality is probably the hindering cause, and mechanical appliances of not too great power should be tried. Some of this character have been mentioned in Part III, Chapter 2.

Dr. A. E. Matteson* has devised an appliance for producing forced elongation of several of the incisor teeth at the same time. It is composed of a rubber plate to which a piece of clock spring, properly shaped, is attached. The spring is cut and ground along its outer edge in such manner as to leave projections to pass between the teeth at their necks and bear upon the wider parts of the crowns. After being properly shaped and fitted, the spring is riveted to the anterior portion of the plate just back of the teeth to be acted upon. In inserting the appliance, the projections of the spring are passed between the teeth at their necks and the plate pressed into place. The elasticity of the slightly curved spring with its projections, will produce pressure upon the teeth in the direction of their length and cause their elongation.

The action of all appliances of this character will have to be closely watched to see that the power produced by them is not too great nor too long continued.

Should any or all of the appliances mentioned fail to move the partially erupted tooth, we may safely conclude that its root is exostosed or curved at some point of its length, and further operations had better be suspended.

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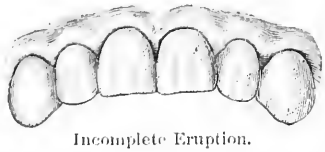
* Harris' Principles and Practice, 12 Ed. p. 439.

The author, in his early practice, attempted to rotate a superior cuspid tooth, and after failing to produce any effect by the commonly adopted appliances, concluded that the trouble must lie in the formation of the root. A digital examination of the tissues overlying the root, revealed the fact that it was considerably curved, and further efforts at rotation were immediately abandoned. Had the examination been made before beginning operations, as it should have been, instead of at their close, much annoyance and trouble would have been spared both patient and operator.

Where full eruption of a tooth has been made impossible by the impingement of adjoining teeth upon the space intended for it, increase of space by lateral pressure upon the interfering teeth should first be gained before any attempt is made at elongation. Indeed, the mere enlargement of the space and its retention for a length of time will usually be followed by the unaided eruption of the tooth. Should this not occur, mechanical assistance may be rendered by some of the methods mentioned.

Forced eruption of a tooth by means of the extracting forceps is seldom justifiable, for we cannot always know what may have interfered with the eruption. In certain exceptional cases, where a careful examination reveals no sign of malformation of the root, and where it is perfectly evident that slight impingement of adjoining teeth has been the sole hindrance to full eruption, the forceps may prove a valuable means of effecting a rapid and easy correction of the difficulty.

FIG. 127.



Incomplete Eruption.

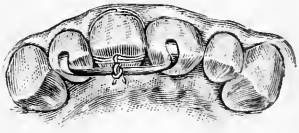
Such an exceptional case once occurred in the author's practice. The patient was a gentlemen of about twenty-eight years of age, whose right central incisor was about a line shorter than its mate. It had been tardy in erupting and in consequence there was a slight lack of space for its accommodation, as shown in Fig. 127.

As the difference in length of the two incisors was too great to be remedied by the simple means of reducing the length of the longer one, it was decided to elongate the shorter one. A careful examination proving favorable, a piece of sand paper was folded so as to cover both labial and palatine surfaces of the tooth to protect it from injury, after which it was grasped with the forceps and by a combined rotary and downward motion brought into place. Once in position, it was held there firmly by the pressure of the adjoining teeth, but as good judgment would not sanction so unreliable a means of retention, an appliance had to be devised that would not only prevent the tooth from slipping back into its socket but also secure it from being forced forward by pressure upon its sides. The patient also desired the appliance to be as inconspicuous as possible.

To accomplish all of these ends, a piece of platinized gold wire, a little thicker than a vulcanite tooth-pin, was bent into horseshoe form and curved to conform to the palatine surfaces of the assisted tooth and the two adjoining ones. The ends of the wire were then flattened and bent so that they would hook over and rest upon the cutting edges of the adjoining central and lateral. A silk ligature was passed around the moved tooth and tied in front, after which the ends were again passed to the palatine surface and tied just below the cingulum. After the gold wire was placed in position, the ligature was attached to it at the lowest point of its central curve.

The ligature thus held the appliance in position and it in turn held the tooth from receding. The double arrangement of wire and ligature also guarded the tooth against the possibility of moving forward. The fixture in position is shown in Fig. 128. The only parts of it visible were the small rounded gold tips that overlapped the cutting edges of the two adjacent teeth.

FIG. 128.



Retention after Correction.

Where sufficient space exists for the purpose, the tooth after being drawn into position, may be held there by means of the platinum band and extension bar, as shown elsewhere for retaining a tooth that has been forced backward into the line of the arch.

TOOTH-SHAPING.

During the act of regulating or after its accomplishment, one of the most useful accessory operations, when called for, is that of dressing or shaping certain teeth so as to still further improve their appearance.

This operation will probably not be necessary in the majority of cases we treat, but when indicated, it adds immensely to the patient's appearance and the satisfaction of the parents and operator. It may be accomplished by means of the file, corundum point, sand-paper disk or emery cloth strips, each having its value according to the requirements of the case.

It will not often be called for on the approximal surfaces of teeth, but when it is, much of the substance should not be removed, and the surface should afterward be polished in the most perfect manner.

The author has had one case, and one only, in which such trimming of approximal surfaces seemed advisable. The patient was a young lady of about twenty-one years of age, whose anterior superior teeth were slightly prominent. The teeth were without interdental spaces and all of the posterior ones were so perfect in structure, alignment and occlusion, that the extraction of even one of them would have been regarded as an unwarranted sacrifice.

All of the six anterior teeth had small cavities upon each of their approximal surfaces, and it was therefore decided that in the filling of these cavities a slight portion of each approximal surface should be dressed off in the hope that the aggregate of such spacing would be sufficient to enable the teeth to occupy a position more in harmony with the normal line of the arch. After the filling and dressing of

the surfaces, the teeth were drawn inward and the result was all that could have been desired.

Sometimes teeth that have been fully erupted out of line, when brought into proper position extend below the line of the cutting edges of their neighbors and the rest of the teeth in the arch. Any attempt to reduce their elongation by forcing them up into the socket would not only be extremely difficult, but in many cases futile. The better plan, if the disparity in length be not great, is to grind off their cutting edges somewhat, and thus accomplish the desired end in a very simple manner.

In other cases, teeth out of line have from lack of attrition preserved their normal, rounded form, while their fellows have been more or less worn away on their cutting edges either through abnormal occlusion or excessive use. When the malposed teeth have been brought into position, their rounded and unworn cutting edges are apt to contrast strongly with the abraded edges of their neighbors. By so dressing the incisive edges of the unworn teeth as to resemble those next to them, greater harmony of expression will be induced.

Altering the form of a tooth, however, may often be made to serve even a more useful purpose than that of appearance. Cases have occurred where an upper tooth, tardy of eruption, has been unable to come entirely down into line owing to its meeting its antagonist of the opposite jaw edge to edge. In such an event, the retarded tooth might be forced sufficiently outward to enable it to accomplish its full eruption and then be held in such position until overlapping had taken place, but the operation may be advantageously simplified in most cases by slightly beveling the edge or cusp of the lower tooth on its labial, and the upper one on its palatine surface. The inclined plane thus formed will enable the upper tooth to slide over the lower one into line, which it will be almost certain to do provided there be no contingent obstructions.

A case of this character came under the author's notice recently in which a superior lateral incisor was thus impeded in eruption until the individual was forty years of age. A simple beveling of the cutting edge of it and its opponent, caused it to come into proper line within a year.

Other conditions than those just mentioned will occur to the practitioner in which the slight alteration of the form of a tooth will materially assist, or be the means of entirely accomplishing some simple act of regulating, and in other cases, greatly add to the effect of some long continued and successful operation in orthodontia.